BRITISH COLUMBIA PROVINCIAL MUSEUM

HANDBOOK No. 44

THE REPTILES OF BRITISH COLUMBIA

by
Patrick T. Gregory
Department of Biology, University of Victoria
and
R. Wayne Campbell
Vertebrate Zoology Division
British Columbia Provincial Museum

Illustrated by
Keith Taylor and Brigitta M. Van Der Raay

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PREFACE

In 1944, the late G. Clifford Carl wrote the first *Reptiles of British Columbia*. It was Handbook 3 of the Museum's Handbook series. In the next 20 years Handbook 3 was reprinted three times. The present book incorporates much of the information in the earlier work and brings up to date the results of herpetological research from the past 30 years.

Many people helped with this handbook. Most of the illustrations were provided by Keith Taylor. However, the drawings of the Snapping Turtle, (*Chelydra serpentina*) the Asiatic (Chinese) Turtle (*Chinemys reevesi*), and the Night Snake (*Hypsiglena torquata*), the "rattle", habitat drawing of the semi-arid desert, and topography illustrations of turtle patterning, lizard scalation, snake scale types and snake scale morphology were supplied by Brigitta M. Van Der Raay.

Drs. Raymond B. Huey (University of Washington), Francis R. Cook (National Museum of Canada) and David M. Green (University of Guelph) critically appraised the manuscript. Linda A. Gregory, A. G. Duncan McIntosh, J. Malcolm Macartney and Donald H. Rivard also provided useful comments. Harold Hosford provided editorial assistance. Erica Gillard typed the manuscript. Doug Blayney provided rough drafts of the topography drawings.

Howard Lacey, who discovered the Night Snake in the province, willingly gave us details of the record. S. Orchard brought the record of the Asiatic Turtle to our attention. Some of the preliminary information we utilized was organized by Michael G. Shepard while he worked at the British Columbia Provincial Museum.

The following institutions provided us with details concerning British Columbia specimens in their collections: American Museum of Natural History, New York (Charles W. Meyers); British Columbia Provincial Museum, Victoria; California Academy of Sciences, San Francisco; Carnegie Museum of Natural History, Pittsburgh (Charles McCoy); Cowan Vertebrate Museum, University of British Columbia, Vancouver (Nasar Din); Field Museum of Natural History, Chicago (Harold K. Voris); Los Angeles County Museum of Natural History (J. Wright); Museum of Comparative Zoology, Harvard University, Cambridge (Franklin D. Ross); Museum of Natural History, University of Illinois, Urbana (Donald I. Hoffmeister); Museum of Vertebrate Zoology, University of California, Berkeley (Stephen D. Busak); Museum of Zoology,

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We are grateful to them all.

Pat Gregory
Wayne Campbell
1983

CONTENTS

	Page
Preface	iii
Introduction	1
Learning More About British Columbia Reptiles	2
Systematics and the Use of Keys	5
Classification	6
Keys	7
General Biology	8
Relationships and Diversity	8
Characteristics	9
Distribution	12
Adaptations to Northern Environments	13
Checklist of British Columbia Reptiles	17
Turtles—Structure	18
Feeding Habits and Habitats	21
Reproduction	22
Growth and Life-span	24
Senses	25
Economic Values	25
How to Find Turtles	25
Key to the Turtles of British Columbia	26
The Family Testudinidae—Fresh-water Turtles	27
Western Pond Turtle	27
Painted Turtle	29
The Family Cheloniidae—Sea Turtles	34
Green Turtle	34
The Family Dermochelyidae—Sea Turtles	37
Leatherback	37
Lizards—Structure	40
Senses	44
The Importance of Colour	44
Thermoregulation	47

Page

Reproduction 48
Defences 49
How to Find Lizards 50
Key to the Lizards of British Columbia 50
The Family Iguanidae—Iguanas and Their Allies 51
Short-horned Lizard 51
The Family Scincidae—Skinks 53
Western Skink 53
The Family Anguidae—Alligator Lizards and Their Allies 55
Northern Alligator Lizard 55

Snakes—Structure 58
Senses 60
Reproduction 61
Locomotion 62
Feeding 63
How to Find Snakes 65
Keys to the Snakes of British Columbia 66
Field Key 66
Laboratory Key 67
The Family Boidae—Boas 69
Rubber Boa 69
The Family Colubridae—Harmless Snakes 71
Sharptail Snake 71
Racer 74
Gopher Snake 76
Common Garter Snake 79
Northwestern Garter Snake 82
Western Terrestrial Garter Snake 84
Night Snake 87
The Family Viperidae—Vipers 89
Western Rattlesnake 89

Introduced and Other Species 94

Glossary 96

Useful References—General Works 98
Field Guides and Handbooks 99
Index 101

LIST OF FIGURES

	Page
Fig. 1. Coding for plates of the carapace and plastron of a turtle	19
Fig. 2. Lizard scutellation	45
Fig. 3. Snake scale types	59
Fig. 4. Scale morphology and row counts	60

PROVINCE OF
BRITISH COLUMBIA
SCALE
MILES
0 50 100
0 50 100 150
YUKON
ATLIN
N W T
CASSIAR DISTRICT
LIARD R
FORT NELSON
STIKINE R
ROCKY MOUNTAINS
COAST MOUNTAINS
PACIFIC OCEAN
ALASKA
WILLISTON LAKE
PEACE R
ALBERTA
DAWSON CREEK
PRINCE RUPERT
SKEENA R
BULKLEY R
NECHAKO R
PRINCE GEORGE
CARIBOO MTS
INTERIOR PLATEAU
FRASER R
THOMPSON R
QUEEN CHARLOTTE IS
VANCOUVER ISLAND
KAMLOOPS
VANCOUVER
VICTORIA
CASCADE MTS
SELKIRK MTS
MONASHEE MTS
COLUMBIA R
Kootenay R
CRANBROOK
IDAHO
MONTANA
U S A
WASHINGTON

INTRODUCTION

Herpetology is the branch of biology that deals with the study of amphibians and reptiles, animals often collectively called *herptiles* or *herps*. The word *herpetology* is derived from Greek words that together roughly mean *the study of creeping things*. It is by virtue of this creeping habit and other characteristics which they share in common that amphibians and reptiles are lumped into one category. They are actually different in many ways and are more properly handled separately. This book deals exclusively with reptiles, specifically those recorded in British Columbia.

Present-day reptiles (about 6,500 species in total) include turtles, the Tuatara (a lizard-like animal from New Zealand), lizards, amphisbaenians (mainly limbless, burrowing animals), snakes, and crocodilians (crocodiles, alligators, etc.). Most living species are found in the tropics and subtropics. About 40 species of turtles, lizards, and snakes occur in Canada as a whole; 18 of these (6 turtles, 3 lizards, 9 snakes) have been recorded in British Columbia. None of our species is exclusively Canadian since all also occur to a greater or lesser extent in the United States. Although the number of species is small, British Columbia has a relatively rich diversity of reptiles compared to other parts of Canada; only Ontario and Quebec have more species. One of the major reasons that we have a fairly diverse reptile fauna is that there is a tremendous variety of habitats in British Columbia, ranging from the hot, dry interior to the coastal rainforests to the marine environment. Our fauna includes species which are adapted to particular habitats within this broad spectrum.

A reasonable question to ask is: Why study reptiles? Reptiles have little direct economic value, although some species may provide food, leather or other products, or contribute to the control of insect and rodent pests. Reptiles also figure to some extent in the art and mythology of various human cultures. By and large, however, reptiles have little direct effect on humans, unless one considers the extreme, and often unwarranted, negative feelings many people have for snakes. Indirect effects are more difficult to assess. The major reasons for studying reptiles are therefore academic. Reptiles, both collectively and individually, demonstrate many unique features, as do all organisms, and are interesting for this reason alone. Their habits and life histories are of considerable interest to natural historians. Reptiles also share some of the characteristics of

various other groups of animals so that we are frequently able to use them for more general studies (physiological studies, for example). Reptiles are also somewhat of a transitional stage in the evolution of birds and mammals and may tell us something about the biology of extinct animals.

A particular research question of relevance to Canadian herpetology concerns the adaptations of reptiles to living in extreme environments. All species in Canada reach the northern limits of their ranges in this country, often in areas where winters are extremely long and cold. Since reptiles depend on fairly high temperatures for much of their activity, how they cope with environments that have long, unfavourable periods each year is of considerable interest (see *Adaptations to Northern Environments*, page 13). It is worth noting that similar difficulties may exist even for reptiles living in the mildest parts of Canada, such as southwestern British Columbia. The ecological problem in this area is not one of severe winters, but may lie in the rather moderate, maritime summers and the frequent cloud cover reducing solar radiation. Continental areas such as the prairies tend to have much warmer, sunnier summers so that the total heat budget available during the active season may be more favourable there than on the coast. This, however, is a more or less unexplored subject. The main point is that despite our small reptile fauna, herpetological work in British Columbia, and in Canada in general, offers its own unique and interesting possibilities.

The objectives of this book are to serve as a general introduction to the biology of reptiles and as a guide to the identification and natural history of British Columbia species in particular. We also hope that this book will encourage interest in conservation and understanding of reptiles since many species, especially snakes, are needlessly persecuted by humans. This is extremely unfortunate because reptiles are truly fascinating animals, providing as much enjoyment to the observer as do birds, plants, or other organisms.

LEARNING MORE ABOUT BRITISH COLUMBIA REPTILES

Since this book is not a technical work on the biology of reptiles, we have chosen to cite literature only sparingly in the text itself. There is, however, a list of useful references at the back of the book that should serve as starting points for anyone wishing to investigate particular

subjects more thoroughly. In addition to these references, three major scientific periodicals published in North America are concerned with the biology of amphibians and reptiles. These journals are *Copeia*, *Herpetologica*, and *Journal of Herpetology*; there are four issues of each yearly. While none of them is likely to be available in most public libraries, past and present issues can be found in university and museum libraries. Another useful periodical is *Herpetological Review*, also published four times a year. In addition, results of Canadian herpetological research appear from time to time in the *Canadian Journal of Zoology*, *Canadian Field-Naturalist*, and *Syesis*.

In writing the accounts of species covered in this book, we have attempted as much as possible to draw on information collected on British Columbia populations. Little research has been done on our native herpetofauna, however, so that we have often had to use information collected in studies of the same species in the United States or in other parts of Canada. Readers should have little difficulty in determining what aspects of the biology of the various species are poorly known and where their own observations could shed light on some of these more poorly known areas. This is especially true for distribution data. The distribution maps show only point localities where species have been recorded, so that the gaps in our knowledge of the ranges of species are obvious. New range information is of considerable interest. Reports of apparent range extensions and new locations should be made to the Vertebrate Zoology Division, British Columbia Provincial Museum, in Victoria, and be accompanied either by a series of detailed photographs of the animal, or

the specimen itself. Reports of species previously unrecorded in British Columbia definitely should be accompanied by the specimen. Freezing is probably the simplest humane method for killing reptiles, but several other techniques may be used. See *Methods of Collecting and Preserving Vertebrate Animals* by R. M. Anderson (chapter by F. R. Cook) for a discussion of this subject. Dead reptiles are best preserved in a solution of 5–10% formalin; the body cavity should also be slit open or injected with the solution for thorough preservation. Complete collecting data (date, weather, habitat, etc.) should be included. Field data sheets are available on request from the Vertebrate Zoology Division, British Columbia Provincial Museum in Victoria.

Finally, a word or two should be said about collecting reptiles. Special tools or techniques are often required to capture reptiles; we mention some of these in the introductions to the various groups. At present, no permit is required for the collection of any British Columbia reptiles, except on protected lands such as parks and ecological reserves. Many people have originally developed an interest in herpetology by maintaining a few live reptiles in captivity or by keeping a collection of preserved specimens, so such practices are not to be discouraged completely. Two cautionary comments should be made, however: Never collect large numbers of a given species from one locality, especially gravid (pregnant) females; and do not keep poisonous snakes as "pets". The first comment is based on considerations of conservation, while the second is a matter of safety. It is not unknown for the owners of rattlesnakes to end up in hospital, courtesy of their supposedly tame charges. Aside from the rattlesnake, however, several of our native species make interesting captives, although feeding may be a problem in winter. Enough books on the care and feeding of captive reptiles are available in libraries and pet shops that this subject will not be covered here. The bibliography by Campbell *et al.* (1982) (listed in the References at the back of this book) contains many important references on the maintenance of reptiles in captivity.

SYSTEMATICS AND THE USE OF KEYS

Systematics may be defined as the simultaneous study of the evolutionary relationships of organisms and the naming of those organisms. As such, it encompasses taxonomy, which is simply concerned with the cataloguing of organisms. Although the debate as to what constitutes a good taxonomic system is still going on, the nomenclatural system used by most biologists is the one put forward by the Swedish botanist Linnaeus in 1735. Basically, the Linnaean system of nomenclature is a hierarchical one. The animal kingdom is divided into a number of phyla (singular: phylum), which are themselves broken up into classes. Progressive subdivisions beyond this are orders, families, genera (singular: genus), and species (both singular and plural). As needed, other levels may be added between these, usually indicated by means of prefixes such as *super-* and *sub-* (e.g. a *super*family would be a subdivision of an order and consist of one or more families). Determination of these various levels is generally made on a morphological basis, but no specific criteria are used in defining any level except for species. Most biologists recognize a species as being a group of potentially interbreeding organisms. Although this definition presents a number of difficulties, it is at least a useful conceptual framework. On a practical level, morphological features are often used as diagnostic characters, allowing us to tell species apart. Readers should realize, however, that reproductive isolation, and not degree of morphological similarity, is the ultimate criterion used in naming species.

The Linnaean system has several important features. One is that the words used as names are generally of Latin or Greek origin (or Latinized versions of someone's name, etc.). This makes the system international, allowing biologists in all countries to understand what animal is being discussed. A second feature is that each species is described by a binom consisting of the generic name (beginning with a capital letter) followed by the specific name (no capitals). These two make up the complete scientific name of the species (e.g. Western Terrestrial Garter Snake, *Thamnophis elegans).* The generic name is roughly analogous to the surname of humans, while the specific name is analogous to the given name. These names frequently describe some morphological feature of the animal or indicate the animal's geographic origin. In some species, two or more geographically and morphologically distinct subspecies are

recognized. If the subspecies category is used, the subspecific name is added after the generic and specific names to form a trinom (e.g. Wandering Garter Snake, *Thamnophis elegans vagrans*). Finally, the name of the person(s) (sometimes abbreviated as in L. for Linnaeus) who originally named the species or subspecies is often appended at the end.

In this book, each species of reptile which occurs in British Columbia is introduced by its binom, while mention of any recognized subspecies is made in the account of each species. Also the name(s) of the person(s) describing the various forms is listed. We have also made use of standardized common names in English for each recognized species and subspecies. While not of much use outside North America, such names are often of considerable value to laymen on this continent. We have followed *Standard Common and Current Scientific Names for North American Amphibians and Reptiles* (by the Society for the Study of Amphibians and Reptiles) in our use of common names. A blanket common name is used for the species as a whole, while separate common names are used for the various subspecies.

Classification

A partial classification of modern reptiles, to the family level and with particular emphasis on groups found in British Columbia (marked by *), is shown below:

Phylum Chordata—tunicates, *Amphioxus*, vertebrates
  Subphylum Vertebrata—vertebrates
    Class Reptilia—reptiles
      Subclass Anapsida—anapsids
        Order Chelonia—turtles
          Suborder Cryptodira—turtles other than sidenecks
            * Family Testudinidae—turtles other than sidenecks
            * Family Cheloniidae—most marine turtles
            * Family Dermochelyidae—leatherback sea turtles
      Subclass Lepidosauria—tuatara, lizards, snakes, amphisbaenians
        Order Rhynchocephalia—tuatara
        Order Squamata—lizards and snakes

Suborder Lacertilia—lizards
* Family Iguanidae—iguanas, horned lizards, others
* Family Scincidae—skinks
* Family Anguidae—alligator lizards, many limbless species
Suborder Amphisbaenia—amphisbaenians
Suborder Serpentes—snakes
* Family Boidae—boas and pythons
* Family Colubridae—most harmless snakes (plus some rear-fanged poisonous snakes)
* Family Viperidae—vipers and pit vipers
Subclass Archosauria—crocodilians

Keys

To simplify the identification of the various species, we have constructed a dichotomous key for each major group (turtles, lizards, snakes). A dichotomous key is based on easily recognizable, external, morphological features and is generally applicable only in the particular context for which it is intended. For example, the keys in this book would be of little use in California, where more species occur, because some of the morphological characters considered to be diagnostic in separating species in British Columbia might be shared by other species in California. A dichotomous key is used by starting with character "1" and deciding whether "1a" or "1b" describes the specimen you are examining. If the scientific name of a species is indicated after your choice, you have identified the specimen. If not, move on to the next character indicated and choose which of "a" and "b" is appropriate again. Continue this process until an identification has been made. Use of keys is sometimes difficult at first, but they may be used efficiently with practice. Readers should encounter little difficulty with the keys presented here, since so few species are involved. We have constructed one key each for turtles and lizards since not many species occur in either case and none of the species is dangerous. A specimen that is captured can therefore be easily examined and identified. Snakes, on the other hand, represent more than half the British Columbia reptile fauna, some species are fairly similar in appearance, and one, the Western Rattlesnake (*Crotalus viridus*), is venomous. The Night Snake (*Hypsiglena torquata*) may be mildly venomous but is too small and inoffensive to be dangerous to

humans. For these reasons, we have constructed two keys to the snakes—one for use in the field and one for use in the laboratory, especially when examining dead specimens. Caution should still be exercised when handling dead specimens since snake venom does not lose its potency immediately upon the death of the animal; a scratch from a fang could therefore be dangerous.

GENERAL BIOLOGY

Relationships and Diversity

Reptiles are vertebrates, a major animal group that also includes fishes (several classes), amphibians, birds and mammals. Vertebrates as a whole are the animals people are most familiar with, because these animals are often large and/or conspicuous. Also, we are vertebrates ourselves and we rely on other vertebrates as the major source of protein in our diet. Basically, vertebrates have an internal skeleton of bone (sometimes cartilage), divided into various elements that allow movement of body parts as well as support the body and protect internal organs. Of particular note in the skeleton are the backbone elements, or vertebrae (hence the term vertebrate), and the skull; both are present in all vertebrates.

Reptiles are a fairly old vertebrate group, apparently having evolved from primitive amphibians. The oldest reptile fossil dates back about 350 million years. As a group, reptiles reached their peak about 180 million years ago, at which time they were the dominant land vertebrates and included now-extinct forms such as dinosaurs, plesiosaurs (large aquatic reptiles), pterosaurs (flying reptiles), and others. Most of the species and major categories of reptiles that have ever existed are now extinct. The present-day reptile fauna includes 231 species of turtles, one species of rhynchocephalian (the Tuatara, *Sphenodon punctatus*), 3,723 species of lizards, 122 species of amphisbaenians, 2,408 species of snakes, and 23 species of crocodilians. The Tuatara is of considerable interest since it is the last representative of a formerly more widespread group that was contemporaneous with the dinosaurs. The snakes and lizards, especially the former, are the most recently evolved of our present-day reptiles, both having diversified in much the same time period as have the mammals. In British Columbia, only turtles, lizards, and snakes are represented.

Characteristics

As a group, reptiles are interesting because, besides possessing certain unique features, they essentially form a link between the "lower" (older) and "higher" vertebrate groups. In this sense, the lower vertebrates are the fishes and amphibians (which arose from a group of fishes), while the higher vertebrates are the birds and mammals, both of which evolved separately from now-extinct reptile groups. For example, reptiles are "cold-blooded," are not particularly intelligent and generally do not have well-developed parental care of young. These are all characteristics which we usually associate with lower vertebrates. Of course, in terms of its ecology, a reptile does not necessarily have to be particularly intelligent or invest a lot of time in parental care because there are many alternative means of existence in the world. The association of certain characteristics with older or more recent groups is by no means a measure of the "success" of a group. Still, it is quite reasonable to describe reptiles as the lowest of the higher vertebrates because many species of reptiles, like birds and mammals, are completely terrestrial animals, breathing by means of lungs and free from the necessity of being near or in water for breeding and other functions. Even highly aquatic reptiles such as the marine turtles and sea snakes show many of the features which have allowed reptiles to become truly terrestrial. Most amphibians are not liberated in this way and, although some show a much reduced dependence on water, they have not been as successful in invading the world's driest habitats as have reptiles, birds, and mammals.

The major feature which allows these latter three groups to be completely terrestrial is the amniotic egg, although this characteristic is not so

apparent in mammals because most are live-bearing. (For this reason, reptiles, birds, and mammals are often called amniotes, while amphibians and fish are called anamniotes.) The important point about the amniotic egg is that the developing embryo is bathed in fluid which is completely enclosed by a membrane called the amnion; the entire structure is surrounded by a shell, thus protecting the embryo from mechanical damage and, to some extent, from desiccation. In the case of birds, the incubating parent controls water loss from the eggs by regulating the relative humidity of the nest microclimate. This is not the case in reptiles. Most reptiles tend to lay their eggs in somewhat moist places, which is a greater constraint than is imposed on birds. Moist microhabitats do occur in most places at some time or other, however, and reptile eggs are still much more resistant to desiccation than are amphibian eggs, because reptile eggs are both shelled and relatively large. It is therefore not surprising that many reptiles occur in very dry, terrestrial environments. Live-bearing reptiles, of course, avoid this problem completely.

Other features which are believed to be related to the problem of terrestrial existence are the epidermal scutes, or scales, covering the body, which are believed to reduce water loss, and the production of urine consisting mainly of uric acid and little water. The role of the external scutes in reducing water loss has recently been called into question because scute-less reptiles seem no less resistant to desiccation than normal ones.

Many kinds of reptiles, however, have secondarily returned to a marine or fresh-water existence in varying degrees. Water supply is obviously not a problem for fresh-water forms, but marine species encounter physiological problems because of the salinity of the sea and must be able to excrete excess salts from the body. It should be noted that no reptiles lay eggs in water, but are obliged to return to land to lay their eggs. Only live-bearing aquatic snakes such as sea snakes are exempt from this requirement (all but one species of sea snakes are live-bearers).

In reptiles, fertilization of the egg by sperm is internal (within the body of the female, as in all amniotes); in all cases, except the Tuatara, this is accomplished by means of a copulatory organ in the male. The copulatory organ of turtles and crocodilians is a single penis, whereas lizards and snakes possess a pair of hemipenes (singular: hemipenis), although only one is used at a time. The Tuatara mates by cloacal contact between the two sexes, as do most birds.

Some of the supposedly more primitive features of the reptiles also bear further examination since they are not necessarily shown by all species. For example, it has recently been discovered that several species of crocodilians show elaborate parental care and protection of eggs and young, and other social behaviour. Some snakes and lizards are also known to brood their eggs. (It should be noted that a few species of fish and amphibians, both "lower" verebrate groups, also show some degree of parental care.) Territorial lizards show a fairly high degree of social interaction, much like birds.

Equally interesting is the characteristic of cold-bloodedness. This is really a misnomer that has resulted from the observation that the body temperatures of reptiles, like amphibians and fishes, are markedly affected by temperatures of the ambient environment, so that in extremely cold conditions the animals are extremely cold. A more appropriate term than cold-blooded is ectothermic, indicating that body temperature is determined mainly by factors external to the body, including various environmental temperatures (i.e., air and soil). By contrast, birds and mammals are endotherms in that they maintain constant body temperatures by physiological heat generated within the body. There are two known cases of significant endogenous heat production in reptiles. Some female pythons make use of physiologically generated heat (produced via shivering) when brooding eggs. There is also evidence that the Leatherback (*Dermochelys coriacea*) may be endothermic, producing heat by muscular activity. Ectothermic reptiles can, however, maintain body temperatures at a fairly constant level by behavioural thermoregulation (as opposed to physiological thermoregulation in endotherms). Behavioural thermoregulation is especially well known in lizards and consists of such actions as shuttling back and forth between sun and shade (use of different microhabitats), hiding in cool shelters in hot conditions, changing postures to alter contact with the substrate and surface area exposed to the sun, and changing orientation to the sun. Under extreme heat stress, panting may occur. Panting lowers body temperature by evaporative cooling, similar to sweating in humans.

Of course, reptiles can thermoregulate this way only over a relatively narrow range of ambient conditions, unlike many endotherms, and can not tolerate very cold or very hot conditions, especially the latter. Very low temperatures will kill all reptiles, but most species can tolerate a drop

in body temperature to a few degrees below freezing (as low as −8°C in some cases). In addition, the correlation between body and environmental temperatures is far from perfect in some environments. In fact, an amazing independence from environmental temperatures is sometimes achieved. For example, one high-altitude (about 3 900 metres) lizard species in the Andes of South America is capable of maintaining body temperatures of 31°C at air temperatures of 0°C, mainly by absorbing solar radiation. Many reptiles bask in sunlight to raise their body temperature above environmental temperatures. It is even possible that ectothermy has not always been a characteristic shared by all reptiles. It has recently been suggested that the dinosaurs, which may have given rise to the birds, were endotherms. Circumstantial evidence on this point has come from a variety of sources but the question is far from resolved.

Distribution

Reptiles (and amphibians) are most abundant in the tropics and subtropics of the world, becoming less abundant towards the poles. For example, about 300 species of reptiles occur in Mexico, 20 in Washington State, 18 in British Columbia, and only one in the Northwest Territories and Alaska. Less information is available on distributions in parts of the southern hemisphere, but the same trends are apparent. Only two reptiles are known to occur regularly above the Arctic Circle, the Viviparous Lizard (*Lacerta vivipara*) and the Northern Viper (*Vipera berus*) in Scandinavia, although two other species approach the Arctic Circle in that area and the Leatherback (*Dermochelys coriacea*) has been recorded as a wanderer within the Circle. In British Columbia, the Common Garter Snake (*Thamnophis sirtalis*) and the Western Terrestrial Garter Snake (*Thamnophis elegans*) occur the furthest north of all our reptiles. Large reptiles such as crocodilians, most sea turtles, giant tortoises, the larger boas and pythons, and the Komodo Dragon (*Varanus komodensis*), the world's largest lizard, are particularly restricted to warmer, less variable climates. There are at least two reasons for this: large animals, which have relatively small surface area/volume ratios, do not exchange heat with the environment as rapidly as do small animals so that rewarming after a cold spell (frequent in temperate areas) might be very difficult; and large animals, because of their size, are less able to find warm microhabitats in cold conditions, including the critical winter period when it is

necessary to find a hibernating site below the frost line. This second point may be particularly important since most temperate areas experience varying degrees of winter and terrestrial reptiles are unable to migrate long distances to avoid winter conditions as do many birds. Presumably, these restrictions are less important for marine reptiles since aquatic environments are more stable than terrestrial environments. Also, at least some marine reptiles, such as sea turtles, are capable of long-distance movements. This is why they are occasionally seen in temperate, and even polar, waters during the warmer months of the year. These turtles, however, breed only in the tropics and subtropics.

ADAPTATIONS TO NORTHERN ENVIRONMENTS

The northern parts of the north temperate zone have long, cold winters and short, variable summers with moderate average temperatures. Reptile species diversity in such areas is low since few species are adapted to such extreme conditions. The few species that do occur in northern areas often show considerable variation in numbers from year to year, apparently in response to variations in weather. Low summer temperatures may reduce reproductive output of reptiles (by slowing the rate at which embryos develop or by causing development to cease altogether). High mortality, usually due to freezing, is often recorded for reptiles in hibernation, so that the occasional occurrence of exceptionally cold winters may be a real limiting factor on the northern distribution of

reptiles. Similar considerations apply to the extreme southern parts of the south temperate zone and to high-altitude localities. Despite these difficulties, the reptiles that do occur in northern areas are often numercially very abundant and the question arises as to what adaptations allow them to exist in such environments. Although little research has been done on northern adaptations of reptiles in British Columbia, studies done elsewhere provide much insight into this problem.

Two obvious features of northern reptiles in general are: Most are either lizards or snakes (only members of these groups occur in reproductively viable populations north of the Arctic Circle); and a high proportion are live-bearing (including both species that occur north of the Arctic Circle). In British Columbia, 12 of our 18 resident species of reptiles are lizards or snakes, and among these, two of our three lizard species and five of our nine snake species are live-bearing. The three most northerly

distributed reptiles in British Columbia are all live-bearing snakes (the Rubber Boa, *Charina bottae;* the Common Garter Snake, *Thamnophis sirtalis;* the Western Terrestrial Garter Snake, *Thamnophis elegans*). Perhaps one restriction on the distribution of turtles is their failure to have evolved the live-bearing habit. In general, viviparity (the live-bearing habit) in lizards and snakes in cool climates is believed to be advantageous because the female, by thermoregulating, can provide the optimum temperature for embryonic development of the young. There is some evidence in fact that gravid females of some viviparous species behaviourally maintain a slightly different and/or less variable body temperature than do males and non-gravid females. On the other hand, eggs laid and untended by oviparous (egg-laying) species are at the mercy

of the vagaries of the environment. Since development rate of reptile embryos is related to temperature, the incubation time of eggs of oviparous species may be very long in cool summers. This is a great disadvantage in areas where summers are fairly short to begin with.

Of course, there are also disadvantages to viviparity. Female snakes which spend several months carrying young do not feed very often and consequently show reduced growth (reptiles generally grow throughout their lives, albeit at a decreasing rate with age). Since litter size is related to female body size in most reptiles, future litter sizes might be smaller than they would otherwise have been. Also, in places where the growing season is very short, females may give birth so late in the summer that they do not have enough time left to feed sufficiently to obtain the necessary nutrients for reproducing again the following year. As a result, biennial reproductive cycles are shown by females in northern populations of various species of snakes. This phenomenon has not been demonstrated in live-bearing lizards, which are apparently able to reproduce in successive summers. Presumably, egg-laying snakes can also reproduce every year. The short growing season of northern areas generally restricts reptiles to the production of only one brood of young per year.

In addition to reproductive adaptations, northern reptiles show various physiological adaptations to cold. Generally speaking, northern reptiles are better able to move and perform other functions at low temperatures compared to reptiles from warmer climates. Many species in northern regions also show a marked ability to acclimate to changing conditions That is, a brief exposure (a few days) to cool conditions will allow them to function normally at lower temperatures than they would have been able to without such exposure. This is a particularly advantageous ability in the autumn as the weather becomes progressively cooler. The reverse process, acclimation to higher temperatures, occurs in the spring. Some northern reptiles can adjust to lower temperatures instantaneously (i.e., without a period of acclimation) through a built-in mechanism for raising the metabolic rate (rate of biochemical reactions, including respiration), relative to other reptiles, at fairly low temperatures. Thus, these reptiles can continue activity in cool conditions. This ability is especially advantageous in northern areas during spring and fall when weather can be unpredictable. During winter, however, temperatures drop too low for

activity of any kind and northern reptiles must hibernate. Although the metabolic rate of hibernating reptiles is much lower than that of animals active in summer, hibernating reptiles must rely on a limited supply of stored energy reserves such as fat. Since northern winters may be very long, any adaptation which allows food reserves to be conserved is advantageous. Several species of northern reptiles in fact reduce energy expenditures during hibernation by depressing the metabolic rate much below what it would be even at the same temperatures in summer. This is apparently an acclimation response to low temperatures, but in the opposite direction to the acclimation response discussed above.

Reptiles in northern areas, especially snakes, often pass the winter at communal hibernating sites or dens. Dens may be used by hundreds, or even thousands, of animals at a time and a given den is often used year after year by the same individuals. Communal hibernating sites of snakes are usually in rocky outcrops or talus slopes where crevices in the rock allow the animals to get underground below the frost line to hibernate. In British Columbia, the most spectacular examples of communal hibernation are provided by rattlesnakes which den in large numbers, sometimes with other species of snakes, at various sites in the Okanagan Valley. Garter snakes are also known to hibernate in large numbers at dens in northern British Columbia. The reason for communal denning is unknown. In some cases, it may simply reflect a shortage of suitable hibernating sites in the immediate area. However, reptiles which hibernate at communal dens also derive some benefits in terms of reproductive success. Most temperate zone reptiles mate in spring shortly after emergence from hibernation; communal hibernators often mate right at the den itself. They therefore do not waste too much time and energy finding mates and can turn to other activities such as feeding. This is important in northern regions where the growing season is very short. It is doubtful that communal hibernation offers any advantages in terms of heat retention, especially since the hibernating animals are not necessarily in contact with one another.

The adaptations of reptiles to northern environments therefore involve a complex of physiological, ecological, and behavioural features. Further work in this general area offers some of the most promising possibilities for herpetological research in British Columbia.

CHECKLIST OF BRITISH COLUMBIA REPTILES

The following list includes subspecies recognized in British Columbia.

		Page
TURTLES		
*Chelydra serpentina**	Snapping Turtle	94
C.s. serpentina	Common Snapping Turtle	
*Clemmys marmorata**	Western Pond Turtle	27
C.s. marmorata	Northwestern Pond Turtle	
Chrysemys picta	Painted Turtle	29
C.p. belli	Western Painted Turtle	
*Chinemys reevesi**	Asiatic (Chinese) Turtle	94
Chelonia mydas	Green Turtle	34
C.m. agassizi	Pacific Green Turtle	
Dermochelys coriacea	Leatherback	37
D.c. schlegeli	Pacific Leatherback	
LIZARDS		
Phrynosoma douglassi	Short-horned Lizard	51
P.d. douglassi	Pigmy Short-horned Lizard	
Eumeces skiltonianus	Western Skink	53
E.s. skiltonianus	Western Skink	
Elgaria coerulea	Northern Alligator Lizard	55
E.c. principis	Northern Alligator Lizard	
SNAKES		
Charina bottae	Rubber Boa	69
Contia tenuis	Sharptail Snake	71
Coluber constrictor	Racer	74
C.c. mormon	Western Yellowbelly Racer	
Pituophis melanoleucus	Gopher Snake	76
P.m. catenifer	Pacific Gopher Snake	
P.m. deserticola	Great Basin Gopher Snake	
Thamnophis sirtalis	Common Garter Snake	79
T.s. fitchi	Valley Garter Snake	

* Introduced and probably extirpated.

Checklist of British Columbia Reptiles—*Continued*

Snakes—Continued		page
T.s. parietalis	Red-sided Garter Snake	
T.s. pickeringi	Puget Sound Garter Snake	
Thamnophis ordinoides	Northwestern Garter Snake	82
Thamnophis elegans	Western Terrestrial Garter Snake	84
T.e. vagrans	Wandering Garter Snake	
Hypsiglena torquata	Night Snake	87
H.t. deserticola	Desert Night Snake	
Crotalus viridis	Western Rattlesnake	89
C.v. oreganus	Northern Pacific Rattlesnake	

TURTLES

The turtles are a very old group of reptiles, dating back 200 million years. They are also a conservative group in that their basic body has not changed appreciably during that time. The body structure is the most outstanding external feature of turtles; it is unlikely that turtles would be confused with any other kind of animal.

Structure

The main structural feature of turtles is the bony shell which more or less encloses most of the body and serves as a defense against predators. The shell consists of three main parts: an upper domed carapace, a lower plastron, and a bridge joining these two on each side of the body. The carapace is derived from the ribs, vertebrae, and dermal bones which develop in the skin, while the plastron is a combination of ventral ribs and dermal bone. Overall, the shell consists of a large number of bony plates which are covered by epidermal scutes or laminae. The arrangement of the bony plates and of the laminae are similar; however, the margins of these two structures are not coincident, but overlap. The laminae are the external plates seen on the shells of most living turtles and are generally named according to the scheme shown in figure 1 on page 27.

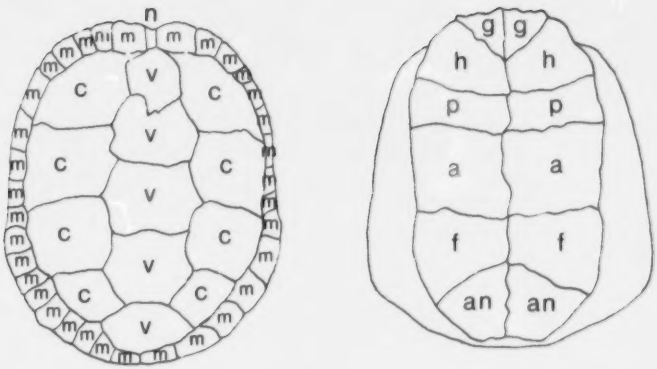


Fig. 1. Coding for plates on the carapace and plastron of a turtle. Left, dorsal view (carapace); right, ventral view (plastron). a = abdominal, an = anal, c = costal, f = femoral, g = gular, h = humeral, m = marginal, n = nuchal, p = pectoral, v = vertebral.

In many species of turtles, rings corresponding roughly to the annual rings of trees appear on the outer margins of the laminae during growth. Several factors influence the appearance of these rings, however, so that counting them is not necessarily a reliable means of aging turtles. Turtles also have various scutes on the head which are named in a similar way to those of lizards and snakes.

The shell is of interest for a couple of reasons. First, because the carapace is partly composed of the ribs of the animal, the ribs in turtles are above or outside the shoulder girdle. In all other vertebrates the opposite is true—the ribs are inside the girdle. The arrangement in turtles is achieved through some fairly complicated embryological changes. Second, the shell, while of protective value, also imposes certain limitations on turtles. For instance, in most vertebrates the mechanics of drawing gases into and moving gases out of the lungs is partly due to muscular actions resulting in contractions and distentions of the thorax. Obviously, this option is not open to an animal contained within a rigid shell. In turtles, gas exchange between lungs and atmosphere is accomplished by

the contraction of muscles in the abdominal region. These muscles act to change the pressure in the body cavity and thus allow respiration. Because some of the muscles involved in breathing are located near the base of the legs, breathing movements can be seen in slight movements of the legs.

Other limitations of the shell are that it restricts speed of movement and imposes a considerable weight load on the animal, especially on land. In fact, many modern turtles have a somewhat reduced shell. Shell reduction in most sea turtles is accomplished mainly by a great reduction in the size of the plastron, but the largest sea turtle, the Leatherback (*Dermochelys coriacea*) also has a drastically reduced amount of dermal bone in its shell and no laminae, giving a soft leathery appearance to the shell. As a result of these and other adaptations, marine turtles are able to move at considerable speed. The fresh-water softshell turtles show similar structural modifications of the shell, but in this case the changes are also believed to be related to increasing camouflage for an existence on the muddy bottoms of rivers. Turtles having highly reduced shells obviously cannot withdraw their heads and legs and make full use of the shell's protective potential. Not surprisingly, many of these turtles compensate for this by being large and/or aggressive. Softshell turtles, snapping turtles, and musk turtles are good examples of such animals. The highly terrestrial tortoises also have a reduced shell, but this time the reduction is mainly one of thickness and is related to the problems of mechanical support of a heavy body on land.

Despite these modern trends, the shell is important as a protective structure. Many turtles have partial or complete hinges (called plastral hinges) on the plastron; one African tortoise has a hinge on the carapace. The hinge allows the shell to be closed to a greater or lesser degree once head, legs and tail have been drawn in. Most such turtles have only a single hinge and cannot close their shells completely, but the American box turtles (*Terrapene*) and can close their shells tightly. The North American mud turtles (*Kinosternon*) have two plastral hinges.

There are two major groups of turtles, the suborders Cryptodira and Pleurodira, which are most easily distinguished by the manner in which the head is retracted into the shell. The cryptodires make a vertical S-bend in the neck when withdrawing their heads. The pleurodires, or "side-necks," on the other hand, withdraw their heads by bending the

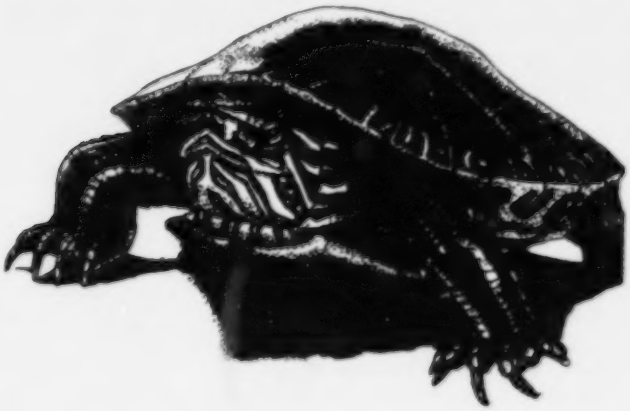
neck laterally. Cryptodires occur virtually wherever turtles are found; all North American turtles belong to this group. The pleurodires are restricted to the tropics.

Feeding Habits and Habitats

Turtles demonstrate a variety of feeding habits and include herbivores, carnivores, and omnivores. None, however, have teeth, the cutting edge instead being a horny beak. The feet are also sometimes used to assist in breaking up large food items.

Turtles occur in a variety of habitats; this has led to some confusion in the naming of different kinds of turtles, especially between North America and Britain. In this book, the word "turtle" is used as a general term for all members of the Order Testudines. Specialized terms such as "terrapin" (small aquatic or semi-aquatic turtles other than sea turtles, especially those eaten by humans) or "tortoise" (land turtles of the family Testudinidae, subfamily Testudininae) are sometimes applied to particular ecological types. On a habitat basis, turtles can be arranged on a continuum from highly aquatic to completely terrestrial.

The most highly aquatic are the sea turtles with their aforementioned reduced shells, and their modified wing-like forefeet or flippers. The flippers are in fact raised and lowered like the wings of a bird when in use



and are highly effective organs of propulsion. The hind legs of marine turtles are also flipper-like to some extent and are highly webbed. Most aquatic fresh-water turtles also have well-developed webbing between the toes of their feet, especially the hind feet. This webbing is considerably reduced in more terrestrial species. The most highly terrestrial turtles are the tortoises which are almost incapable of swimming. Their feet are stumpy and elephant-like, although burrowing varieties generally have massive front limbs for digging. Most turtles have clawed feet, although in marine turtles there are only one or two claws on each flipper. Leatherbacks (*Dermochelys coriacea*) have no claws.

Many aquatic turtles can remain underwater for long periods of time because of their so-called pharyngeal and/or cloacal "gills". These structures are not true gills but simply highly vascularized (i.e. with many small blood vessels) areas of the walls of the pharynx (throat) or cloaca (chamber in which digestive, reproductive, and urinary tracts terminate) through which a small amount of gas exchange can take place between the water and the circulatory system. The fact that turtles are ectotherms and do not have high oxygen requirements is also adaptive in this sense. In addition, turtles have well-developed capacities for anaerobic metabolism (metabolism without oxygen).

Despite their adaptations to life in water, many aquatic turtles make frequent forays overland and, of course, all turtles are ultimately tied to the land for reproductive purposes since they are all oviparous.

Reproduction

As in other reptiles, fertilization in turtles is internal. The male has a single copulatory organ called the penis which is housed in the base of the tail. Courtship may be almost non-existent or fairly elaborate, depending on the species. Perhaps the best described courtship behaviour occurs in the painted turtles and sliders (*Chrysemys and Pseudemys*), in which the male faces the female and strokes and caresses her head with his long front claws. Copulation may last a considerable time in some species (up to six hours in the Green Turtle, *Chelonia mydas*, for example). The male turtle usually remains on top of the female by hooking his hind legs under the female's shell in various ways depending on species. In sea turtles, however, the male attaches himself to the female shell by his front legs.

Sexual dimorphism is fairly well developed in turtles, although to varying degrees in different species. In most, the male has a longer tail to house the penis and the cloacal opening occurs nearer the tip of the tail. Also, the male frequently has a more concave plastron than the female to facilitate mounting her mounded shell when mating. The sexes may be of different sizes, may have different sized heads, or may be slightly different in colour. As mentioned above, in some species of turtles *Chrysemys*, the males have very much longer foreclaws than do females. This characteristic is readily observed in the Painted Turtle (*Chrysemys picta*), which occurs in British Columbia.

The females of many species can store spermatozoa from a single mating for up to four years, producing clutches each year, albeit with a steadily decreasing proportion of fertile eggs. Clutch size varies greatly from species to species, but may be very large (up to about 200 in the Green Turtle, *Chelonia mydas*). Many species also appear to regularly lay two or more clutches of eggs in a breeding season, at least in the warmer parts of their ranges. In most species, eggs are laid in a nest which is a

flask-shaped hole dug in some appropriate substrate (sand, rotting wood) by the female, using mainly her hind feet. After laying her eggs, the female usually fills in the hole. She also may make some effort at concealing the nest from predators by spreading soil around or repeatedly passing over it. For sea turtles, this is really the only time the adults (and only the females at that) emerge onto land; their modified structure makes them very clumsy out of the water. Various predators take a heavy toll of eggs laid by many species. In temperate areas, hatchlings often overwinter in the nest.

Growth and Life-span

Turtles are generally long-lived provided they can get by the early stages of growth when they are small and vulnerable. Many species may live up to 50 years. Box turtles (*Terrapene*) probably exceed 80 years in maximum life-span. Reports of older specimens are difficult to verify but some may be true, especially those applying to very large species of turtles such as giant tortoises. Contrary to popular opinion, however, turtles do grow rapidly under natural conditions and many species, including some sea turtles, are sexually mature by the age of three years.

Most species reach maturity within the first ten years of life. On the other hand, the Desert Tortoise (*Gopherus agassizii*) of the southwestern United States takes 15–20 years to mature.

Senses

The most important senses of turtles are olfaction, which seems fairly well developed, and vision, which is extremely well developed. Both are probably used in the detection of food. Turtles have good colour vision. The ability to distinguish light of different wavelengths seems to be important in guiding hatchlings of aquatic turtles in the "right" direction (i.e. towards the water) upon emergence from the nest. Despite having a complete auditory apparatus, turtles apparently do not pick up air-borne sounds well, but they are sensitive to substrate-borne vibrations.

Economic Values

The economic importance of turtles is and has been mainly as a source of food for humans. Most species are edible, although many are not large enough to be worthwhile. The hunting of turtles (and their eggs) has put a strain on many turtle populations, necessitating various conservation measures. Turtles have also played various roles, usually favourable, in the folklore of human cultures. Turtles are not of any direct economic value in British Columbia; the Painted Turtle (*Chrysemys picta*), however, probably plays an important role as a scavenger in lakes and ponds.

How to Find Turtles

All species of turtles occurring in British Columbia are aquatic. The two marine turtles are only occasionally seen in the ocean and never emerge onto land in our area. Fresh-water turtles are most obvious during sunny weather when they can be seen in ponds and lakes basking on logs or other objects, or simply floating at the surface. Painted Turtles in British Columbia are most often seen this way. Various kinds of traps have been developed for catching live turtles in water. Aquatic turtles may also be found in the mud at the bottom of bodies of water. This can be accomplished by diving or, sometimes, by wading in shallow water and searching for them by hand. Many species of aquatic turtles also make occasional overland treks, especially females during the nesting season,

and can be seen crossing roads in daylight. Painted Turtles in British Columbia are not uncommonly encountered on land. Strictly terrestrial turtles, which do not occur in this province, are usually seen when they are active during daylight.

Key to the Turtles of British Columbia

1a. Forelimbs in the form of elongate flippers with one claw at most; in marine habitat; may be up to 1 or 2 metres in length; head and limbs not retractile 2

1b. Forelimbs with claws; almost always in fresh-water habitat; shell never more than ¼ metre long; head and limbs retractile 3

2a. Leathery shell and skin with no scutes; no claws on forelimbs; prominent longitudinal ridges on carapace ..... *Leatherback* ***(Dermochelys coriacea)***

2b. Carapace with laminae; large scutes on head and tail; one claw on each forelimb ..... *Green Turtle* ***(Chelonia mydas)***

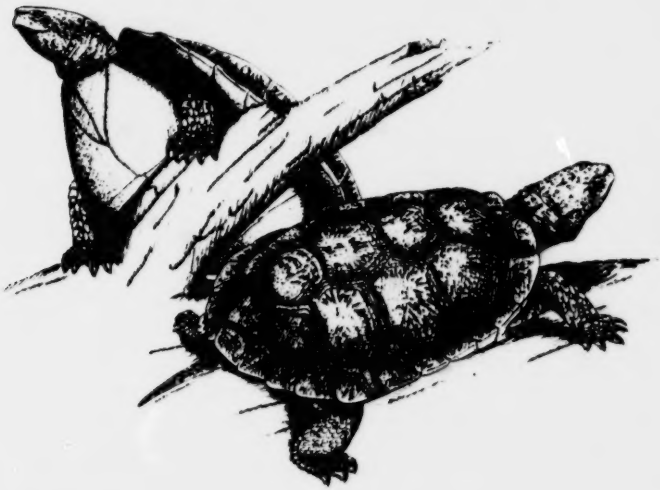
3a. Coloration dull brown or blackish, with irregular black or brown markings ..... *Western Pond Turtle* ***(Clemmys marmorata)***

3b. Carapace black or olive brown; plastron bright red with large black blotch in centre; head and limbs black or olive with bright yellow markings ..... *Painted Turtle* ***(Chrysemys picta)***

THE FAMILY TESTUDINIDAE—FRESH-WATER TURTLES

Western Pond Turtle ***Clemmys marmorata*** (Baird and Girard)

Description—Carapace low, relatively smooth, and longer than wide; hatchlings and/or young turtles have a more roundish carapace with a mid-dorsal, longitudinal keel and concentric ridges on each lamina. Plastron also smooth, and fairly flat (more concave in males). Adult carapace yellowish, olive-brown, or sometimes blackish; sometimes a pattern of black or brown dashes and spots radiates from the growth centre of each lamina, but this pattern is often absent. Plastron yellowish with irregular black or brown markings, which are sometimes absent. Head, tail, and limb yellowish, with dark brown or black spots and flecks on head. Scutes on limbs large, especially on forelegs, with irregular brown markings. Hind feet fairly well webbed. Irregular brown markings on tail. Claws long and slender.



Western Pond Turtle

Habits and Habitat—This species is possibly extinct in British Columbia, having been collected only twice (in 1933 and 1936) and last reported in 1966. Perhaps its status in British Columbia is partly or wholly related to the fact that it was exploited as food by humans early in the twentieth century and possibly earlier. In fact, the Western Pond Turtle may never have occurred naturally in this province; the two records could be of turtles which escaped after being imported from the south for food. In any case, all of our knowledge of this turtle is based on studies done elsewhere. It is important that any sightings of this species in British Columbia be reported to the British Columbia Provincial Museum in Victoria; in view of the rarity of Western Pond Turtles in this province, collecting by private individuals is discouraged.

The Western Pond Turtle is highly aquatic and is usually found in quiet ponds, marshes, or streams with muddy bottoms and emergent aquatic vegetation. However, it is occasionally found in brackish water and has even been known to enter the sea. This species is quite omnivorous, feeding mainly on aquatic plants and invertebrates, and sometimes carrion. Food apparently must be swallowed underwater. Hibernation generally takes place in the mud at the bottom of the pond or river. This turtle is highly aquatic and is usually seen only when basking on logs or other objects at the surface of the water.

Observations of basking turtles have revealed that this is one of the few species in which there is aggressive behaviour between individuals. Contrary to the situation in Painted Turtles, basking pond turtles do not stack upon one another, but space themselves out through such aggressive displays. Such displays usually consist of stretching the neck and opening the mouth to reveal the vivid yellow and pink of the inside in contrast to the otherwise dull background colour. Occasionally, aggression goes so far as to include biting or ramming. Usually, the recipient of the aggression withdraws its head, goes away, or is knocked off the basking site.

Western Pond Turtles rarely move about on land, although females must emerge to lay eggs. While laying sometimes occurs some distance from water, it usually takes place near the shore of the stream or pond. The eggs are hard-shelled and elliptical, and about 33–43.5 mm long. A clutch of 3–11 is deposited in a cavity excavated in soft soil. The young have a carapace length of about 25 mm.

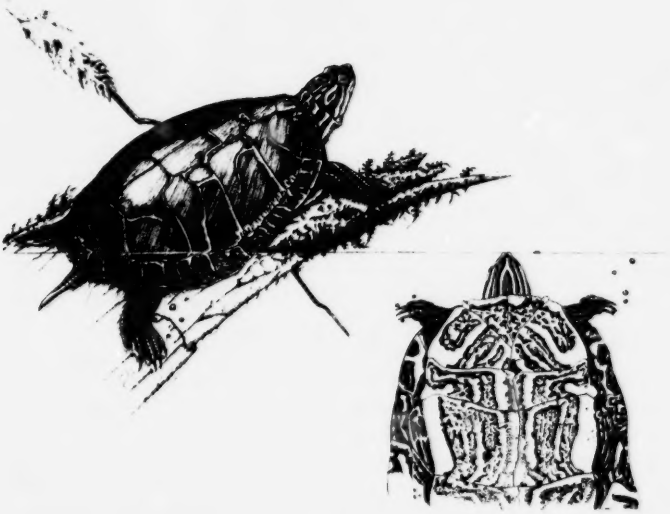
Subspecies—Two are known: The Northwestern Pond Turtle (*C. m. marmorata*) is the one found in British Columbia, if the species occurs naturally here.

Range and Distribution—Coastal Oregon, California, and Baja California; isolated populations in Washington and western Nevada. In British Columbia, specimens have been taken only from the Greater Vancouver area.

Painted Turtle ***Chrysemys picta*** (Sneider)

Description—Carapace low, relatively smooth, and longer than wide; hatchlings have a more roundish carapace with a mid-dorsal, longitudinal keel. Plastron also smooth and fairly flat (more concave in males). Adult carapace up to 250 mm long; females usually larger than males. Carapace black, brown, or olive, sometimes with a light yellow reticulated pattern, and/or a faint mid-dorsal line running lengthwise. Marginal scutes usually marked with yellow at upper edges and red underneath. Plastron with a large black central blotch with branches extending along scute margins; bright red otherwise. Reddish markings on bridge. Head, tail and limbs olive green or blackish, with yellow lines on head and tail, and small yellow spots on limbs. Male with very long claws on forefeet. Hind feet well webbed.

Habits and Habitat—Although this species is common in parts of British Columbia, much of what we know about it is based on studies of Painted Turtles in other parts of North America, particularly the northeastern United States. It is a highly aquatic species found in ponds, lakes, and streams with muddy bottoms, slow-moving water, and emergent aquatic vegetation. The Painted Turtle is very common in such situations, often occurring at densities of 500 or more per hectare. Feeding, mating, sleeping, and other activities generally take place in the water, but movements of several hundred metres on land are not uncommon. Such movements are most common in spring and fall when many turtles move between ponds where they spend the summer and hibernating ponds. Other turtles may use the same pond year round. Long-distance homing ability seems well developed; successful homing over distances of up to



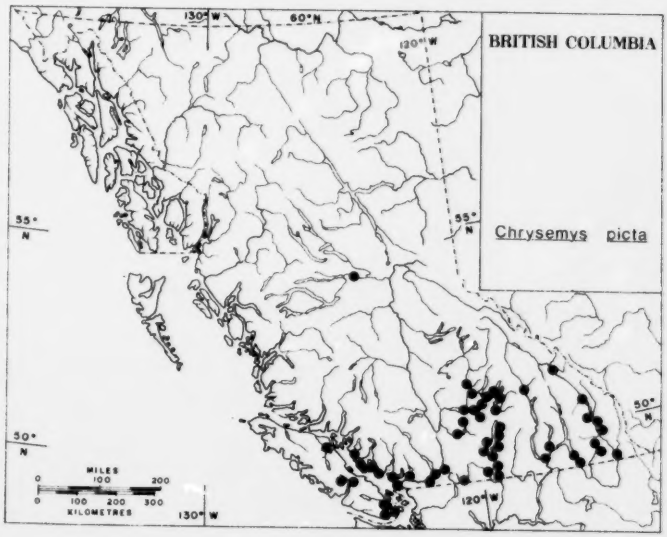
Painted Turtle

three kilometres has been recorded. The only other conspicuous terrestrial activities are nest-digging and egg-laying. Painted Turtles usually hibernate by burrowing in the mud at the bottom of a pond. In mild climates, hibernation may not occur or, if it does, be very brief, although activity is always reduced in winter. Painted Turtles have occasionally been seen swimming under the ice, especially in spring.

This species is generally active during daylight, although nest-digging and egg-laying most often take place in the early morning and late evening, and therefore partly in darkness. Painted Turtles are particularly conspicuous in warm, sunny weather when they are frequently seen basking in large aggregations on suitable sites such as logs, mudbanks, or other objects above water. No aggression between individuals is shown at such times, the turtles often piling on top of one another until they are two

or three deep. Basking is an important part of the thermoregulatory behaviour of Painted Turtles since they can easily adjust their body temperatures in summer by moving into and out of the water. Turtles may bask for a couple of hours at a time, but the duration of basking is related to air temperature and other weather parameters. Turtles often maximize their exposure to the sun by spreading their legs and basking completely out of the water.

Painted Turtles are quite hardy compared to other species and generally do not hibernate for as long as do other species with which they coexist. Temperature, however, is still an important factor governing many aspects of their life history. The length of the active season and hibernating period are governed by water temperature, as is the onset of breeding activity. Spring movements are correlated with warm, sunny weather. Males are active earlier than females in spring. Within a given active season, temperature determines when feeding and other activities occur. Consequently, growth rate is also a function of temperature, as is true for other reptiles.



Feeding and Growth—Adult Painted Turtles are omnivorous. Juvenile turtles are almost completely carnivorous, feeding mainly on small invertebrates. As they grow, however, they switch to larger animal prey such as frogs and fish and begin to eat more vegetation, which is less nutritious than meat but easier to obtain. Scavenging is also practised commonly by adults. Like many aquatic turtles, Painted Turtles have difficulty swallowing unless underwater. Growth of young turtles is rapid, but the growth rate decreases as sexual maturity is approached and is slow from then on. Males usually mature at the age of four years, and females at five years. Under some circumstances, both sexes may reach maturity as early as two years of age.

Reproduction—Courtship and mating usually take place in spring when the water has begun to warm up, although they sometimes occur in fall. Generally, these activities are restricted to shallow water and are the only activities in which any degree of intraspecific aggression is involved. Such aggression occurs between males and usually consists of a larger male driving away smaller individuals. In courtship, several male turtles may actively chase a female. When one male finally catches up to her, he swims in front and faces her, with his front legs outstretched by the sides of his head, palms outward. The male then uses his long claws to tickle or stroke the female's head at short intervals. Between stroking bouts, the male swims away, "enticing" the female to follow him. Sometimes the female may stroke back and, occasionally a female may even initiate courtship (and drive away other females). Courtship generally lasts about five to 15 minutes, after which the female sinks to the bottom of the pond, followed by the male, who then mounts her. Copulation always takes place underwater.

Nesting occurs on land, usually within 150 metres of water. Nest sites may be selected in fields or pastures, on beaches or roadsides, or in any situations where digging is fairly easy. Slopes with a southern exposure and good drainage are often chosen. Painted Turtles generally begin nesting in June, but may start in May where the climate is mild. The female turtle usually urinates on the chosen site before she begins to dig. Presumably, wetting the soil makes it easier to dig. Urination may be repeated at intervals during the excavation process. The nest-hole is flask-shaped when completed. Following this, a clutch of 3–16 eggs is deposited. The individual eggs are up to 35 × 18 mm in size when laid. The

female then refills the nest-hole and may pack down the soil by passing over the site several times. Often, the nest location is then covered with debris such as leaves and twigs. Some females may produce two clutches in a season. The egg stage is one of the most vulnerable phases of the life cycle of the turtle since egg predators, especially mammals, are abundant. Mortality of both eggs and young turtles is much greater than of adults. The young, upon hatching in late summer, may not immediately emerge from the nest, especially in northern populations. Rather, they overwinter in the nest and emerge the following spring. Hatchlings have a carapace length of about 25 mm.

Subspecies—Four are known: The Western Painted Turtle (*C. p. bellii*) is the largest of the four and the only one occurring in British Columbia.

Range and Distribution—From the Atlantic to Pacific Oceans in southern Canada and the northern United States; widespread in the southeast, along the Mississippi River and on the northern plains of the United States, but absent from the Great Basin, southwest, and Pacific Coast.

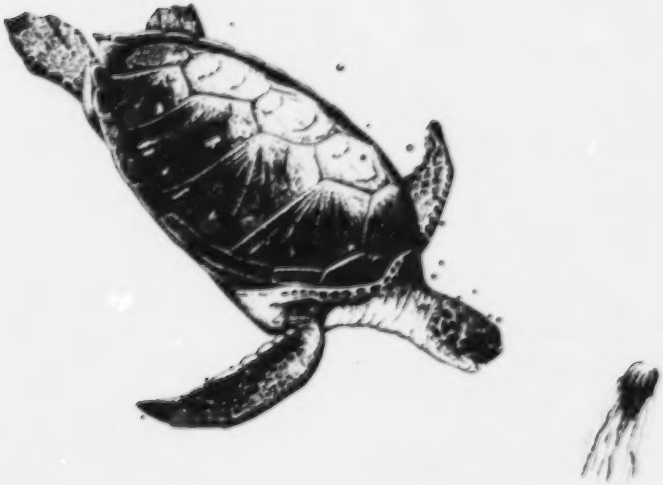
In British Columbia, this turtle is restricted to the southern part of the province. It is most abundant in the Okanagan Valley and the Kootenay region, but also occurs on the mainland coast, on Vancouver Island, and on some Gulf Islands. There is some question as to the status of coastal populations of Painted Turtles. Vancouver Island populations for example, are probably the result of accidental introductions of escaped pets. In any case, the species does not seem to be abundant in any coastal localities.

The northern interior record (Vanderhoof) is probably also an escaped pet.

THE FAMILY CHELONIIDAE—SEA TURTLES

Green Turtle ***Chelonia mydas*** (Linnaeus)

Description—Carapace smooth, with laminae and serrated posterior margin; anterior margin not extending beyond base of forelimbs and neck. Carapace longer and narrower in male. Plastron relatively small. Adult carapace up to 1.5 m long. Head, limbs, and tail covered with scutes. Limbs paddle-shaped, especially forelimbs which are elongate flippers; large, curved claw on each forelimb. Tail short in female but long and prehensile with horny tip in male. Carapace olive or brownish; plastron pale yellow or white. Head, limbs and tail olive-yellow.



Green Turtle

Habits and Habitat—The Green Turtle is mainly tropical and subtropical. No permanent populations occur in British Columbia; only one specimen has been recorded in our waters, in 1954. Since Green Turtles are known to wander great distances in the sea, the specimen sighted off our coast was probably just off course. This species tends to occur in shallow seas such as over the continental shelves, where vegetation is abundant. The adults feed mainly on such vegetation although they may also eat animal food such as jellyfish. The young apparently feed on small invertebrates. These turtles are highly aquatic and rarely emerge onto land except to lay eggs. Males therefore may never come out of the water, although basking Green Turtles (usually females) have been seen on the rocks of remote islands. Basking individuals, however, are more likely to just float at the surface where they sometimes also sleep. In the Gulf of California, Green Turtles hibernate in winter partially buried in the bottom sediments.

Reproduction—Breeding is an especially interesting aspect of the biology of Green Turtles. This activity, however, does not take place in British Columbia. The main breeding sites of the Green Turtle in the Americas are on the east coast of Costa Rica and some Caribbean Islands. Nesting also occurs in Australia, certain islands in the Indian Ocean, and various other places. Nesting areas, or rookeries, are always sandy beaches, where digging is easy. Nesting beaches are usually used by large numbers of individual turtles. Many large rookeries have been wiped out all over the world through human depredations, since the turtles are particularly vulnerable when nesting. How individual turtles are able to home in on specific breeding areas over long distances in the sea remains one of the mysteries of Green Turtle biology.

Mating takes place in the shallow water just off shore, either at the surface or on the bottom, and peaks before egg-laying begins. Females and copulating pairs may be accompanied by several males, who presumably compete for mates. Courtship in Green Turtles is a strenuous activity with the female ultimately determining, through the use of various tactics, whether or not mating occurs. Copulation itself may be six hours in duration. Males may copulate many times in a single breeding season, but each female mates only once. This single mating, however, usually provides enough sperm for the production of four or more clutches per breeding season.

The female lays each clutch separately, at intervals of one to two weeks. On each occasion, she emerges onto land, usually at night and at a high tide, to crawl laboriously up to a suitable nest site well above high tide. Movements on land are frequently accompanied by much groaning and sighing due to expulsion of air from the lungs resulting from the great mass of the turtle's body. In the water, which is a more buoyant medium, the turtle's mass does not have this effect. Nest-digging is a long, elaborate process and may take several hours. Once the nest is dug, the female lays a clutch of about 100 to 110 eggs. The eggs are spherical and about 46 mm in diameter. After laying, the nest is refilled with sand and its exact location apparently hidden by the general disturbance of the sand in the area. Finally, the female heads back to sea, having been on land, in some cases, most of the night. This process is repeated on every nesting occasion in a given breeding season. Breeding seasons for individual turtles are apparently two or more years apart, the intervening years being occupied by extensive migrations. The hatchlings (about 50 cm in carapace length) usually dig their way out of the nest at night but may wait until daylight before heading for the water.

Mortality—The major predators of adult Green Turtles are large carnivores such as sharks and killer whales. Presumably the turtle's tendency to sleep underwater under the protection of overhanging ledges is an anti-predator behaviour. Green Turtles and their eggs have been highly prized as food by man for several hundred years and have been heavily exploited. Consequently, much important conservation work has been done on this species and, as a result, our knowledge of its biology is fairly great, at least for the adults.

While eggs in the nest are subject to heavy predation, the young turtles moving between the nest and the sea are perhaps the most vulnerable stage in the life cycle of the Green Turtle. They suffer heavy mortality from a wide variety of predators such as rats, gulls and crabs. What the survivors do after making it to the water is a major mystery. The biology of wild Green Turtles in their first year of life is almost completely unknown.

Subspecies—Two are sometimes recognized: The subspecies recorded in British Columbia waters is the Pacific Green Turtle (*C. m. agassizi*).

Range and Distribution—Totally marine and mainly tropical and subtropical. Occurs in the Atlantic, Pacific, and Indian Oceans.

The only British Columbia record is from Ucluelet.

THE FAMILY DERMOCHELYIDAE—SEA TURTLES

Leatherback ***Dermochelys coriacea*** (Linnaeus)

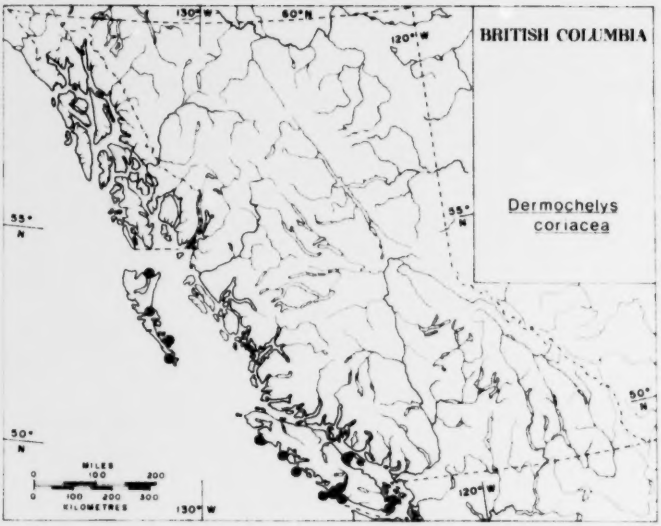
Description—Shell narrow, long, and low; does not extend beyond base of neck and limbs. Carapace up to 2.4 m long (body weight up to 363 kg; rarely 680 kg). Shell consists of polygonal dermal bones (not associated with ribs and vertebrae); covered with leathery skin, but no scutes. Young are covered with small scutes, which are soon shed, and have a keeled, rudderlike tail. Carapace has seven prominent longitudinal ridges; the plastron five. Limbs all paddle-shaped and lacking claws; forelimbs in the form of long flippers; hind limbs broadly connected to tail by a web. Colour uniform black, bluish or greenish black, or slate-coloured, sometimes lightly spotted with yellow or white.

Leatherback

Habits and Habitat—The Leatherback is the world's largest living turtle. It is totally marine and found far out to sea throughout the tropics and subtropics. It has been reported in British Columbia waters about ten times in the last 47 years, but does not permanently reside or breed in this area. Such occasional sightings are probably not surprising in view of the long-distance movements this species seems to make. The Leatherback has been sighted farther north and farther south than any other marine turtle. Apparently, the Leatherback produces heat endogenously by muscular activity and its large body size favours heat retention, so that its body temperature may be well above the water temperature (as high as 25.5°C. when water temperature is 7.5°C.). This, plus the fact that it may seek shallower (warmer) water in colder areas, allows it to be seen fairly often off the Atlantic and Pacific coasts of Canada. The Leatherback is mainly carnivorous and has been reported to gather in schools when feeding on jellyfish, apparently a major food item. It is of some commercial importance in parts of the tropics where oil from the shell is used as a varnish. The eggs are also eaten, both for nourishment and as an aphrodisiac. Like all sea turtles, this species is in need of conservation measures. The Leatherback is considered an endangered species by many.

Reproduction—Leatherbacks are known to emerge onto land only in the egg-laying season and then only the females leave the water. The breeding behaviour of this turtle is much like that described for the Green Turtle. Mating takes place offshore from nesting sites with large numbers of turtles participating. Rookeries, or nesting areas, are sandy beaches, where digging it easy. Up to 1,600 females may nest in a single season at large rookeries. The major Leatherback rookeries are in Malaya and French Guiana, although many other scattered locations are known in the tropics (none in British Columbia or nearby areas).

Females emerge onto beaches at night and laboriously crawl to laying sites where a nest hole is dug. Each individual may lay several clutches per breeding season, each consisting of 90–150 nearly spherical eggs about 50–54 mm in diameter. As in the Green Turtle, egg-laying is usually accompanied by a variety of roars, groans, or sighs. (Leatherbacks are also known to emit loud cries when injured.) The young are about 58 to 63 mm in carapace length upon hatching.



Subspecies—Two are sometimes recognized: Only the Pacific Leatherback (*D.c. schlegeli*) has been seen in British Columbia waters.

Range and Distribution—Totally marine and mainly tropical and subtropical. Occurs in the Atlantic, Pacific, and Indian Oceans.

In British Columbia, Leatherbacks have been reported in the Strait of Georgia, on the west coast of Vancouver Island and off the Queen Charlotte Islands.

LIZARDS

Among living reptiles, lizard species outnumber all other species of reptiles put together. Lizards first arose about 190 million years ago. They are also the most ecologically diverse of present-day reptiles. Although they are mainly restricted to the hotter parts of the world, lizards occur in a great variety of habitats and exhibit many lifestyles. They are also widespread within the tropics, being found on even the most remote islands. Since only three species are known from British Columbia, much of this general introduction will discuss species found elsewhere.

Structure

One of the best indicators of lizard diversity lies in the various means of locomotion they exhibit. For example, in addition to the "normal" walking and running movements practised by four-legged vertebrates, several species of lizards are capable of running for some distance on their hind legs alone, a condition known as bipedalism. The basilisks, a group of Central American species, even do this for a short distance on the surface of water. Their apparent ability to run on water, however, is due to the momentum gained by running off the land at high speed—when escaping predators, for instance. When the momentum is lost, the basilisk sinks into the water as would any other similar-sized animal. An equally bizarre method of getting around is used by the Flying Dragon (*Draco volans*) of Asia, which glides from tree to tree much in the manner of a flying squirrel. This is made possible by a membrane, supported by ribs, on each side of the body. Other arboreal lizards are more conventional than *Draco* in that they can only climb and jump, but even so there is considerable variety of foot structure. Many climbing lizards, such as iguanas, simply have elongated toes with large claws. Most of the geckos, on the other hand, have large flattened toes with transverse plates on the underside which are equipped with clinging setae or hooklets. These lizards can climb a vertical pane of glass and commonly live on the walls of buildings in many parts of the world. The Old World chameleons are also highly arboreal, but grip branches using the opposing toes on each foot and a prehensile (i.e., grasping) tail. Some other kinds of lizards have tails which are prehensile to some degree.

Lizards have invaded not only above-ground habitats, but also underground habitats. Many species of burrowing lizards have either highly reduced limbs or no limbs and may be quite snake-like in general appearance (but have vestiges of limb girdles). Limbless lizards move on the surface of the ground much in the same manner as a snake. The sand lizards (*Uma*), of the southwestern United States, and several African lizards show a locomotory adaptation to yet another kind of environment. These lizards have fringes of scutes on the side of each toe, a modification which apparently increases the surface area of the foot, thereby facilitating rapid movement in their normal habitat of loose sand.

The only environment which lizards have not successfully invaded is the aquatic one. However, the Marine Iguana (*Amblyrhynchus cristatus*) of the Galapagos Islands, although based on land, forages for its food (seaweed) in the ocean just off shore. While foraging, it may dive to depths of 15 metres, swimming with the aid of its laterally flattened tail. Swimming is accomplished by longitudinal undulations of the body, with the limbs closely pressed to the sides.

As might be expected in such a diverse group, lizards run the gamut in body size from the Gecko (*Sphaerodactylus partheopion*) of the British Virgins Islands (1.81 cm long), to the giant Komodo Dragon (*Varanus*

komodensis), a three-metre-long monster restricted to a small area in the East Indies. Included among lizards are carnivores, omnivores, and herbivores, although most are insectivores (including the three species in British Columbia). Lizards have fairly kinetic (i.e., moveable) skulls, although not as much as snakes, so that carnivorous species can frequently swallow fairly large prey. Lizards may also "chew" their food occasionally.

Only two species of lizards are known to be venomous. These belong to the genus *Heloderma* of the southwestern United States and Mexico. The venom delivery apparatus of these lizards is somewhat different from that of snakes since the "fangs" are the teeth of the lower jaw. The venom seeps from glands in the lower jaw and is conducted along simple grooves in the fangs, resulting in much wastage of venom and necessitating the bulldog-grip and chewing shown by the Gila Monster (*Heloderma suspectum*) when it bites. The action of the venom is mainly neurotoxic, but it is not known how important this is as a means of obtaining prey. There are no ducts connecting the venom glands with the teeth; grooves are also present in the teeth of the upper jaw.

The tongue is a highly variable structure in lizards. It is generally forked or lobed to some degree and used in the manner of a snake's tongue, in conjunction with Jacobson's organ (see *Snakes* on page 60) as a sensor of the chemical environment. In the monitors, large tropical predators, the tongue is very much like a snake's and darts in and out frequently. In other lizards, however, the tongue may be broad, flat, and either forked or only slightly bilobed at the tip. In the latter, the tongue may be pink and fleshy, much like the tongue of a mammal, and may be used more to manipulate food inside the mouth than to sense the environment. The Northern Alligator Lizard (*Elgaria coerulea*) and Western Skink (*Eumeces skiltonianus*) of British Columbia have fairly broad pink

tongues with well-defined lobes, at the tips; in both species, the tongue is flicked out fairly frequently during periods of activity. The Old World chameleons, which are arboreal but slow-moving, have evolved an elongate, retractile, sticky tongue which can be shot out at high speed for considerable distances to catch insect prey.

The tail is also an important structure. It may be prehensile and used in climbing. It is also an important organ of body balance in locomotion, is used as a fat storage reservoir in many species, and as a defensive weapon in some species (e.g., iguanas). Perhaps the most unusual attribute of the lizard tail, however, is that many species are capable of autotomy, that is, of shedding the tail from the body. Both the Northern Alligator Lizard and Western Skink readily shed their tails. The tail does not necessarily have to be touched or pulled to be shed, the process apparently being under the lizard's control. The break is not made between vertebrae, but at a fracture plane in the middle of a single vertebra (several tail vertebrae have such fracture planes). The apparent value of such an ability is as a method of distracting predators since the shed tail may wiggle actively for several minutes while the lizard makes good its escape. Lizards that can shed their tails can also regenerate them, although the new growth always looks different from the original and is supported by cartilage rather than by bone. In one group of lizards, the Stump-tailed Skinks (*Scincidae*) in Australia, the tail mimics the head in shape, so that a predator's attention may sometimes be diverted from the head to the less-vulnerable tail.

Early in their history, lizards probably gave rise to snakes and the two groups share many features in common. Some of these, such as the possession of a venom apparatus, the use of the tongue to test the chemical environment, and limblessness, have been mentioned. In addition, lizards are similar to snakes in their reproductive biology. Males are equipped with paired copulatory organs called hemipenes, which are housed in the base of the tail (only one hemipenis is used at a time) and both lizards and snakes may be either oviparous or viviparous. It should be noted, however, that several species of lizards are parthenogenetic (i.e., consisting of females only) and do not require copulation for reproduction. This condition is virtually unknown in other reptiles, although there is recent evidence to suggest that one species of snake may be parthenogenetic. Some lizards, especially those with reduced or no limbs, may shed their skins in one piece as do snakes, although most

lizards moult their skins in several pieces (some may eat the pieces). The skin of lizards often differs structurally from that of snakes in that many lizards possess an armour of dermal bones associated with their scutes. Scutellation patterns of lizards tend to be highly variable and quite different from those of snakes. Figure 2 shows the headshield arrangement of one of our native lizard species (page 45). Unlike snakes, most lizards have well-developed ears, and the tympanum (ear drum) is usually evident on the side of the head.

Senses

The major chemo-sensory apparatus of lizards is the tongue and the Jacobson's organ in the roof of the mouth. Hearing is also fairly well-developed. However, the most important sense in most lizards is probably vision, which plays a prominent role in many aspects of their life history. Most lizards have eyelids, although night lizards (Family Xantusiidae) and most geckos (Gekkonidae) do not. The majority of lizards are diurnal and those that are nocturnal usually have large eyes. All three species in British Columbia are diurnal and all have eyelids. Vision is important in feeding behaviour. Most lizards are insectivores or, more truthfully, generalized small-animal predators, and respond to movements by their prey, although odour also plays a role in the way many species locate their prey. Non-moving prey are often ignored completely. The Old World chameleons, which are slow-moving arboreal lizards, have their eyes mounted on "turrets" which can move independently in search of insects and then focus stereoscopically on an insect when one is found. This is important since chameleons catch their prey by "firing" their tongue, and accurate aim is necessary. Other lizards, which dart short distances at their prey, have no need of such elaborate apparatus, but still rely heavily on vision. In general, carnivorous lizards tend to select their prey on the basis of size rather than type (as do snakes) and vision is also important in assessing this characteristic. Herbivorous lizards use both vision and odour in identifying their food.

The Importance of Colour

Many lizards apparently have well-developed colour vision. The ability to discriminate between different colours may be especially important in certain behavioural displays. In some species, such as the Western

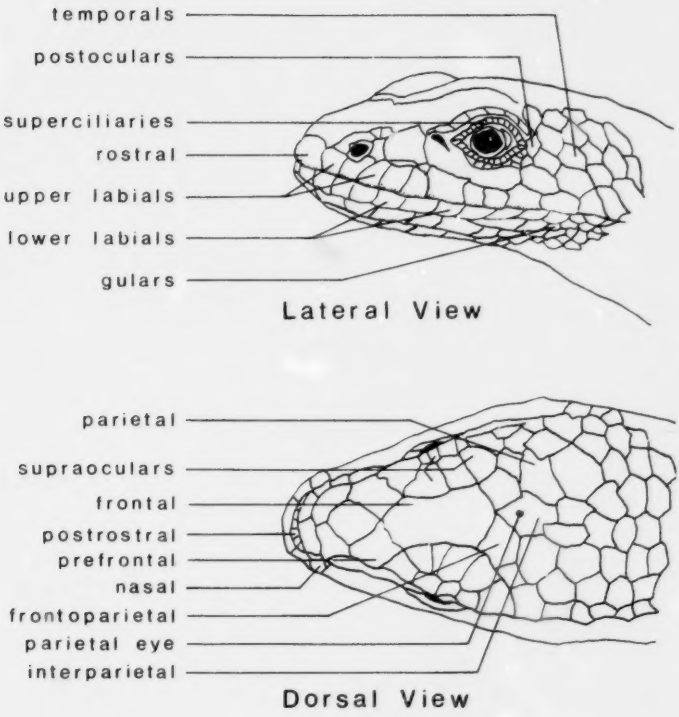


Fig. 2. Lizard scutellation

Skink, the males are more brightly coloured than the females during the breeding season. In addition to functioning to attract females, these colours are probably related to the recognition of other males and the defence of territories against them.

Colour is important to lizards in other ways. For example, in many species (e.g., the Western Skink), the young are particularly brightly coloured on the tail. Since the tail is often easily lost, its bright colour may sometimes serve as an additional predator distraction, allowing the escape of the otherwise vulnerable young. The bright blue tail of young skinks may also serve as an anti-aggression signal to mature males. The young of one African species mimic the colour (and gait) of a noxious beetle, apparently deriving some benefit by being avoided by predators because of this.

Perhaps the most important aspect of colour and pattern in lizards, however, is their role in background-matching or camouflage. Several species such as the Old World chameleons and the New World anoles (commonly sold in pet shops as "chameleons") can actually change colour under certain circumstances. The chameleons are the masters of colour change, being capable of quite a range of colour and pattern. The anoles mainly change from dark brown to bright green. While such an ability would seem to be most advantageous when the colour of the lizard matches its background, background-matching is not the only factor determining colour change. In fact, colour may be due to any or all of state of excitement, health, temperature, and light. Colour change is not shown by any of the native lizards of British Columbia. Even lizards that cannot change colour dramatically can usually change shades, apparently in response to light or temperature changes. Consequently, changes in colour or shade are a means of optimizing heat absorption under different conditions and thereby achieving the optimum temperature. For example, lizards are usually darker when cold because darker colours absorb radiation more readily; however, when hot, a lighter shade, which reflects radiation better, is usually adopted. These changes are due to differences in the dispersion of pigment granules in the melanophores, cells in the dermis layer of the skin. In all cases, the physiological control of the process is quite complex and can be hormonal or neural or both.

The parietal or median eye, present in some lizards and the Tuatara, has been implicated in the control of colour change, but its exact function is

not known. It is situated on the top of the head and is small and incapable of forming images. It does seem to distinguish light from dark and may somehow be involved in thermoregulation.

Thermoregulation

As a group, lizards seem to inhabit much hotter environments than do other reptiles. Lizards can also tolerate higher body temperatures in general and are dominant vertebrates during daylight in deserts. Lizards typically occur in hot environments. They are relatively uncommon in temperate regions, especially temperate forests such as we have in British Columbia. It is not true, however, that lizards are active under the very hottest conditions or that they remain exposed under the hot sun for prolonged periods. The ability to change colour is important in the temperature regulation of large lizards whose body temperatures are significantly related to incoming radiant energy. Body temperatures of small lizards, on the other hand, are more closely related to ambient temperatures and convection; colour change is therefore not so important in thermoregulation of small lizards. Thermoregulatory behaviour is well developed in desert lizards. During the cooler part of the year they are active around the middle part of the day, but in midsummer they may be active only in the early morning and late afternoon, remaining under cover at mid-day. Not surprisingly, desert lizards have proven to be attractive objects for the study of temperature relationships. Much of what we know about the thermal biology of reptiles in general has come from such studies.

Reproduction

Sexual dimorphisms are well developed in lizards. Frequently, the sexes differ in colour and pattern, body size, and other features. Even in species in which there are not fixed colour differences between the sexes, patches of bright colour may develop in various regions of the body of the male or female during the breeding period (e.g., male Western Skinks). One interesting sexual dimorphism is in the degree of development of the femoral pores, which usually occur as a single row on the underside of each hind leg and are usually better developed in males. Each pore has a gland associated with it which secretes a waxy substance. These glands are particularly active in the breeding season. This activity may produce a series of fingerlike projections on the underside of each hind leg. These projections may act to stimulate the female during courtship behaviour. Femoral pores do not occur on either the Northern Alligator Lizard or Western Skink, but do occur on the Short-horned Lizard (*Phrynosoma douglassi*), the third species of lizard known from British Columbia.

The defence of territories is well developed in lizards and is usually associated with breeding (or feeding). Territorial behaviour is mainly practised by males, but is also shown by females in some species. In view of the general importance of vision in species and sex recognition in lizards, it is not surprising that territorial defence usually consists of visual displays. Such displays, in different species, include exposure of bright colour patches on the body, exposure of the brightly coloured gular flap on the throat, and various sorts of bobbing behaviour. The geckos, however, which are mainly nocturnal, may use auditory signals in indicating territory. Many species of geckos are capable of making calls and are apparently the only lizards with pronounced vocal abilities. Courtship behaviour in lizards is variable, although a general statement might be that nocturnal lizards tend to rely on tactile stimulation while diurnal lizards use visual cues. In most species, courtship ends with the male biting the female on the back of the neck, followed by copulation.

Oviparous lizards may use natural cavities to deposit their eggs, but many dig their own nests. Most species dig with their forelegs and refill the hole with their snout and front legs, but some dig with the hind legs. Maternal care of the young is not shown by most species. A few do practice maternal care, however, including care of the eggs during incubation, aiding the young in hatching, and limited care of the young after

hatching. The Western Skink shows limited care of the eggs in the nest. The number of young or eggs per clutch varies depending on species, body size of the mother, and other factors, but ranges from one to 60, with most species producing from two to six.

Defenses

The first line of defense of most lizards against predators is probably flight. This is often accompanied by tail loss to distract the predator (see Structure, page 40). Lizards do, however, show various other defensive behaviours. The most common and most direct, at least when molested, is to bite. Both the Northern Alligator Lizard and Western Skink bite readily when captured. Biting is obviously the best means of defense for the sluggish, venomous lizards of the genus *Heloderma*. Green Iguanas (*Iguana iguana*) of Central and South America may use their long, powerful tails like whips. The rather sharp scutes along the dorsal midline of the tail increase its effectiveness as a weapon. The sharp claws of lizards such as the Iguana, may also be quite damaging to a predator handling the lizard. Another common tactic, in both small and large lizards, is to inflate the body and appear larger, presumably to discourage potential predators. This behaviour is often coupled with a threatening stance and open mouth. If the mouth is opened suddenly, the exposure of the bright colours of the tongue and the cavity of the mouth may startle a predator. The same function may be attributed to the brightly coloured dewlap on the throat of many lizards. The dewlap may be displayed in the presence of a predator and, in addition to the colour effect, may increase the apparent size of the body when viewed from the side.

The Chuckwalla (*Sauromalus obesus*) of the southwestern U.S.A. shows an interesting escape behaviour. When alarmed, it retreats deep into a rocky crevice and inflates its lungs with air, thus wedging itself tightly into the crevice. The lizard can be pried loose only with difficulty. The most bizarre reaction of a lizard to a potential predator is that which is sometimes shown (but apparently rarely) by the horned lizards (*Phrynosoma*) of western North America, represented by one species in British Columbia. These lizards have been known to squirt a stream of blood for a distance of one or two metres from a sinus in the corner of the eye. How such behaviour would function to deter a predator is not clear, but it may be that the blood is distasteful to predators such as coyotes and dogs.

How to Find Lizards

In hot environments such as deserts, most lizards are diurnal and conspicuous when active. Such lizards are usually fast, especially when warm, and difficult to catch without specialized equipment. One useful piece of equipment is a noose of strong thread on the end of a long pole. With this apparatus, the lizard hunter can remain some distance (the length of the pole) from the lizard without frightening the animal. The noose can then be slowly lowered over the lizard's head and around its neck. Nocturnal lizards, on the other hand, may be easier to catch but more difficult to find. When inactive, most lizards hide in burrows, rock crevices, or under other cover objects. In Canada, and other temperate regions, lizards tend to be diurnal and fairly secretive. They are therefore most easily found under rocks, logs, and other cover objects (cover should always be put back into place after examination) and can frequently be captured by hand. In sunny weather, however, our native lizards may be seen basking in the open. Under such conditions, when their body temperatures are high, they are more difficult to catch.

Key to the Lizards of British Columbia

1a. Body short, squat, and flattened, with a short tail (much shorter than length of body); spiny scutes on body and back of head *Short-horned Lizard* ***(Phrynosoma douglassi)***

1b. Body long and slender with pointed snout and long tail (longer than body when intact); no spines on body 2

2a. Colour dull brown with dark blotches (small specimens may be coppery coloured); prominent fold of skin along lower side of body (scutes in area of fold smaller than those on back; noticeable when sides expanded) *Northern Alligator Lizard* ***(Elgaria coerulea)***

2b. Alternating, longitudinal bands of brown and white along dorsal surface; small specimens may have blue tails *Western Skink* ***(Eumeces skiltonianus)***

THE FAMILY IGUANIDAE—IGUANAS AND THEIR ALLIES

Short-horned Lizard *Phrynosoma douglassi* (Bell)

Description—Body short, squat, and flattened; length up to about 75 mm in adults with tail about half as long as body; females slightly larger than males. Head short and approximately as broad as long; legs short. Back and sides covered with spines, with a single prominent row of fringe spines along each side between legs. Short, stout horns at back of head. Males have enlarged postanal scutes on underside, and usually broader tail base than females. Dorsal colour brown, reddish, tan, or grey with 2 rows of dark blotches on either side of midline; a single pair of dark blotches on neck. Ventral surface pale yellow or whitish.

Habits and Habitat—This is the most widespread species of horned lizard in North America. Its range, however, barely extends into British Columbia; the only two known specimens for the province were collected near Osoyoos, in 1910. Sightings of this species should be reported to the British Columbia Provincial Museum in Victoria. Another subspecies of the Short-horned Lizard occurs in southeastern Alberta and southwestern Saskatchewan. The Short-horned Lizard could well be extinct in British Columbia since much of the southern Okanagan Valley has been disturbed by agriculture. Consequently, most of what we know about it has been gleaned from populations in the United States, where it is more common.

The Short-horned Lizard occurs in a variety of habitats from sagebrush deserts to light forests, and at a wide range of elevations. It is most frequently found in open habitats where the soil is loose and sandy, but may be found in rocky areas. It is quite cold-tolerant, which accounts for its occurrence at high elevations and high latitudes. Like horned lizards in general, this species is difficult to find because its colour and pattern tend to match its substrate and because most individuals tend to lie almost motionless until closely approached. In addition, horned lizards frequently bury themselves in sand making it even more difficult to find them. Finally, they are often uncommon compared to other kinds of lizards.

Short-horned Lizard

These lizards are active in daylight. Typically, horned lizards are active earlier in the morning and later in the evening than are other lizards and frequently have quite variable body temperatures. They are "sit-and-wait" predators rather than active pursuers and are often found in the vicinity of ant nests. Ants are a major food of most horned lizards, but the Short-horned Lizard is apparently more catholic in its tastes, feeding on a variety of insects and other small invertebrates.

The defensive tactics of Short-horned Lizards consists mainly of inflating the body and opening the mouth. Presumably, predators are also discouraged by the presence of the spines on the body and on the back of the head. The squirting of blood from the eye, shown by some horned lizards, does not seem to have been recorded for this species.

Short-horned Lizards are live-bearing (probably an adaptation to cold climates) and have been known to produce broods as large as 31. A more usual litter, however, would probably be between five and ten. The young have a body length of about 25 mm when born.

Subspecies—Five are generally recognized: The Pigmy Short-horned Lizard (*P. d. douglassi*) is the only one known for British Columbia.

Range and Distribution—From southern Canada to Mexico and from eastern Kansas to western Oregon and Washington; range somewhat irregular, with several gaps, especially in the extreme southwestern United States, where the species is absent.

In British Columbia, the Short-horned Lizard is known only from the Osoyoos area.

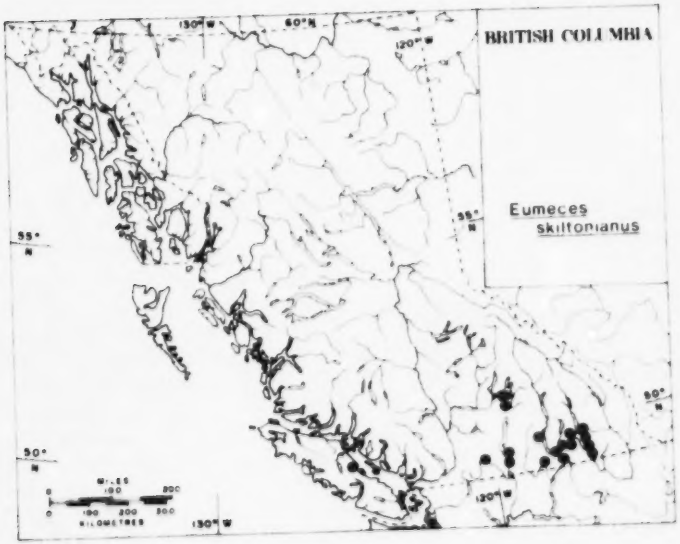
THE FAMILY SCINCIDAE—SKINKS

Western Skink ***Eumeces skiltonianus*** (Baird and Girard)

Description—Body long and slender, up to about 85 mm in adults, with tail longer than body. Head pointed, long, and narrow; legs short. Body covered with smooth, shiny scutes. Colour pattern consists of a broad brownish band down centre of back, flanked by white stripes beginning on head; a broad dark brown band, which begins on head, runs length of animal below each white stripe, with a second white stripe below each brown band. Ventral surface grey or pale blue. Breeding adults, especially males, often develop reddish-orange patches on sides of head and chin, and occasionally under the tail. Striping pattern frequently less clear on tail, which is usually greyish. Pattern of young similar to that of adults, but more vivid and with bright blue tail.

Habits and Habitat—Like other North American skinks, the Western Skink is a secretive lizard and is usually found under cover objects. This lizard, however, is diurnal and is sometimes seen basking in sunny weather. Skinks generally prefer habitats that are damper and less open than those chosen by other kinds of lizards. The Western Skink is most commonly found in areas where there is lots of cover in the form of logs, rocks, leaf litter, and vegetation, and is especially common along river banks. Sometimes this lizard may burrow in soft soil. Its food consists mainly of small invertebrates. The forked tongue is protruded frequently during foraging, but it still relies most heavily on the visual detection of moving prey in finding food. Skinks usually escape from potential predators with a wriggling motion of the body, reminiscent of the locomotion of snakes. The tail is easily shed, which may serve as an important distraction to predators, particularly in the young which have very brightly coloured tails. The bright blue tails of young skinks may also

Western Skink



reduce aggression towards young by adult males. If caught, skinks usually react by biting.

The Western Skink is an egg-laying species. Eggs are deposited in flask-shaped excavations dug in soft soil under rocks or other cover. Clutch varies from two to five and the female frequently stays with the eggs until they hatch. The young have a body length of about 25 mm at hatching.

Subspecies—Three are recognized: Only the Western Skink (*E. s. skiltonianus*) occurs in British Columbia.

Range and Distribution—Southern British Columbia to Baja, California and from the Pacific Coast to Idaho, western Montana, and central Utah; absent from most of the southwestern, as well as the northwestern corner, of the United States.

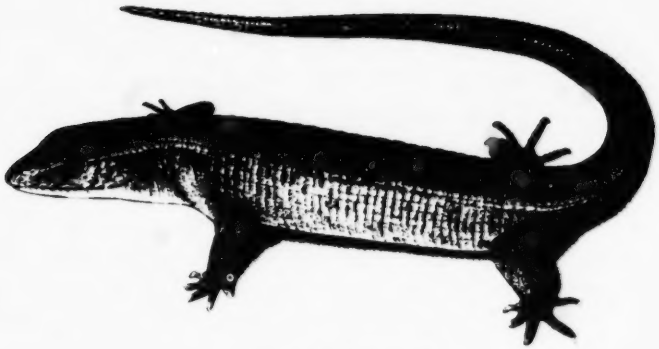
In British Columbia, the Western Skink is found in the south-central and east-central parts of the province. There is, however, one reported sight record for Vancouver Island, northwest of Courtenay.

THE FAMILY ANGUIDAE—ALLIGATOR LIZARDS AND THEIR ALLIES

Northern Alligator Lizard *Elgaria coerulea* (Wiegmann)

Description—Body long and slender, up to 100 mm in adults, with tail longer than body. Head pointed, long, and narrow; legs short. Dorsal surface and tail covered with keeled scutes. A prominent fold of skin running lengthwise along lower side of body. Lateral scutes much smaller than those on dorsal surface (noticeable when sides expanded). Dorsal colour dull brown with scattered black blotches, sometimes forming irregular and/or incomplete transverse bands. Blotches usually largest on sides; sometimes absent from mid-dorsal area. Scattered spots on tail. Ventral surface greyish. Young more metallic in appearance with blackish sides and coppery brown back.

Habits and Habitat—The Northern Alligator Lizard is generally a secretive species and most easily found under cover such as rocks or logs, although it is seen fairly often sunning itself in exposed places. Typical



Northern Alligator Lizard

habitats are open rocky areas, especially near woods, although this lizard may occur right in the forest itself. Like the Western Skink, the Northern Alligator Lizard is sometimes found in somewhat damper conditions than are most other kinds of lizards. The Northern Alligator Lizard is also more tolerant of cold than other lizards, as might be expected considering its northern distribution. Its diet consists mainly of small invertebrates such as insects and spiders. Although sometimes locally abundant, this species is usually distributed fairly sparsely. It tends to be most gregarious in spring and fall around hibernating sites, and less so in summer when dispersed away from such sites. Its main protection against predators is to flee, although it is not particularly fast unless its body temperature is quite high. If caught, it may void the contents of its cloaca, much like snakes, and bite. The tail is especially susceptible to breakage under such circumstances.

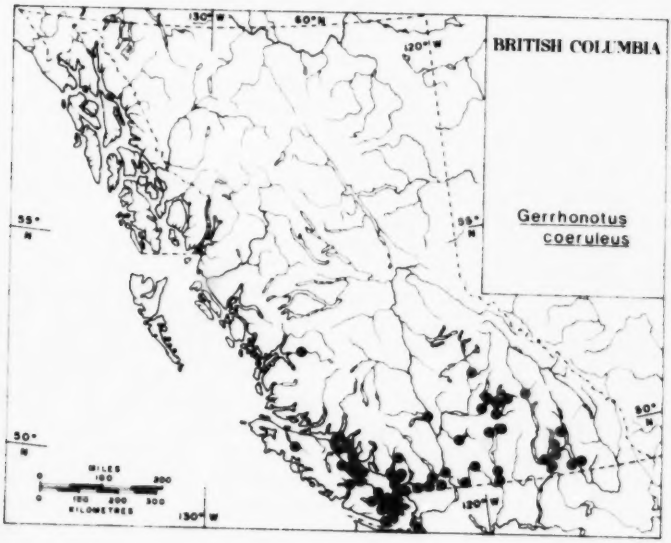
The Northern Alligator Lizard is of minor economic importance since it is the main host of the young stages of the tick, *Ixodes pacificus*. While this tick is not known to transmit any diseases, at high densities it may affect the health of livestock and wild mammals by causing anemia and general irritation.

The Northern Alligator Lizard is live-bearing and may produce from two to 15 young in a brood, but more usually six or seven. Males actively chase the females in courtship. The young are about 35 mm in body length when born.

Subspecies—Four are recognized: Only the Northern Alligator Lizard (*E. c. principis*) occurs in British Columbia.

Range and Distribution—Southern British Columbia and south along the Pacific coast to middle California; also in northern Idaho and eastern Montana.

In British Columbia, the Northern Alligator Lizard is found only in a narrow belt across the southern part of the province, north to Clearwater and Stuie including eastern Vancouver Island. Within this range it is absent only from the extreme southeastern corner of the province.



SNAKES

Snakes are a fairly recent group of reptiles. The earliest known fossil specimen is about 135 to 180 million years old. Snakes therefore began appearing at about the same time as mammals. Snakes are generally believed to have evolved from a burrowing form of lizard and are usually included in the same order as lizards.

Structure

The most primitive of living snakes still have small vestiges of pelvic (hind) girdles and limbs (no snakes have any trace of the forelimbs or pectoral girdle) and many are burrowers. A good local example of such a primitive snake is the Rubber Boa (*Charina bottae*). In general, however, snakes display a streamlined, limbless body form and are mainly terrestrial, although several aquatic species exist. With this body plan, all internal organs are long and narrow, and paired organs (such as kidneys and reproductive organs) are arranged in a linear fashion. In all advanced snakes, only the right lung is present; more primitive snakes, such as boas, have two lungs, but the left one is usually smaller. Snakes are easily distinguished from limbless lizards because of their more flexible body and lack of eyelids. Snakes vary in size from under 30 cm in length to as much as ten metres in the Reticulated Python (*Python reticulatus*) and the Anaconda (*Eunectes murinus*).

The pattern of scutellation in snakes is less variable than that in lizards. The overlapping body scutes are arranged in longitudinal rows on the back and sides. The number of these rows is an important feature in identification. Body scutes may be smooth or keeled, and sometimes pitted. The scutes on the head are similar to those of lizards. The ventral surface consists of a series of transverse, overlapping scutes (ventral scutes) with the posterior end of each scute being free. An anal scute is located immediately in front of the anal opening; this may be single or divided. The ventral surface of the tail consists of subcaudal scutes, which may be single or in two parallel rows, according to species. These features of snake scutellation are shown in figure 4 (page 60).

Snakes shed their skins periodically, the frequency depending upon a variety of factors, especially those affecting growth rate. Prior to shedding, snakes usually become very cloudy in appearance, especially in the eyes, although the eyes may clear up again somewhat just before the

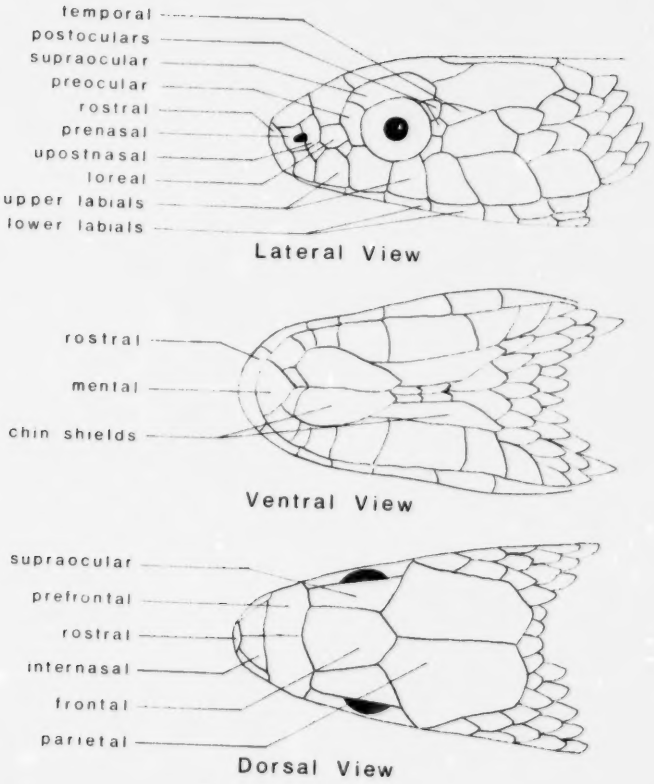


Fig. 3. Snake scale types

moult. The snake sheds by rubbing its snout against a rock or other object and loosening the skin. The skin is then peeled back and removed inside out as the snake moves forward. The skin often comes off in one piece, including the ocular scute over the eye, although it may fragment more easily in large snakes. Since snakes often do not feed in the period before shedding, they usually have a healthy appetite after the process is complete.

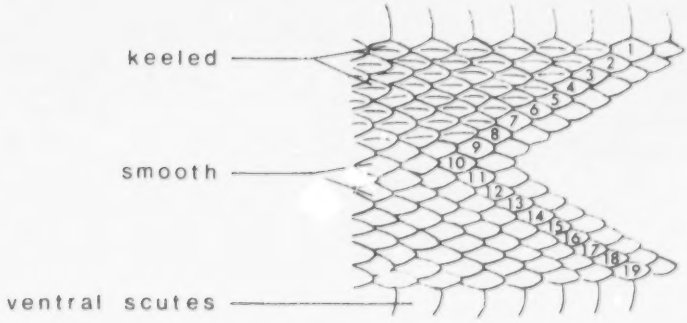
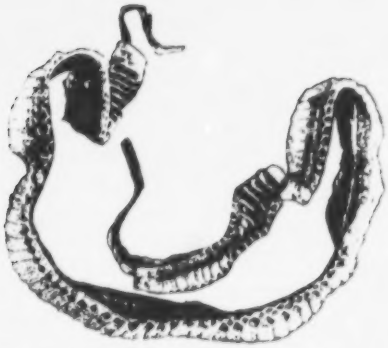


Fig. 4. Scale morphology and row counts

Senses

Most snakes do not appear to have well-developed vision, but can detect movement at short distances. Some primitive burrowing snakes have vestigial eyes. Similarly, snakes have no ears, although they detect airborne sounds of low frequency and vibrations through the ground. The most highly developed sense is that of smell. In addition to the nose itself, snakes possess an allied organ called Jacobson's organ in the roof of the mouth. Chemicals in the air and on the ground are picked up by the two forks of the snake's tongue when the tongue is flicked out and then brought into contact with Jacobson's organ. The tongue is therefore not a



"stinger" but a sensory organ. Several species of snakes (e.g., rattlesnakes) that feed on warm-blooded prey possess two or more heat sensing organs on the head. In some species, these organs are exposed and called pits.

Reproduction

Most of the well-developed behaviour patterns of snakes are associated with feeding, courtship and mating. In reproduction, the odour of the female is important in attracting males and mating itself involves a lot of physical contact between the sexes. Typically, the male lines up alongside the female with his body on top of hers at several points. The male rubs his body, especially his head, up and down the female. In some snakes, such as the Gopher Snake (*Pituophis melanoleucus*), the male bites the female behind the head.

Each male has two copulatory organs called hemipenes, but only uses one at a time. In some species, such as the Common Garter Snake (*Thamnophis sirtalis*), courtship behaviour involving many males and a single female is common, although only one male is usually successful in mating with the female. Copulation with more than one male is probably prevented by the copulatory plug which forms in the cloaca of female garter snakes shortly after mating. Males, however, can mate more than once in a given breeding season. In the temperate latitudes, mating usually takes place in spring (sometimes in fall) and often immediately after emergence from hibernation. As a result, mating activity in many

species, especially those that hibernate in large groups, is frequently confined to the area of the hibernaculum or overwintering site. Courtship and mating of snakes in the wild is easily observed in such cases. Snakes generally overwinter where there is an abundance of cavities in the ground, allowing access below the frost line. Sometimes, the summer habitat may be a considerable distance from the hibernaculum.

While the majority of snakes lay eggs, many species bear their young alive. Egg-laying snakes usually deposit their eggs in soft substrates such as rotting logs, or humus, although some species, most notably certain cobras, may actually build nests out of debris. In at least one cobra species, both sexes may participate in nest-building. In some species of snakes, the eggs are brooded, but parental care is generally poorly developed. In British Columbia, we have six species of live-bearing snakes and three egg-layers. None shows any parental care.

Locomotion

Two of the obvious problems facing limbless, terrestrial vertebrates are locomotion and feeding. The advanced terrestrial snakes have well-flattened ventral surfaces and large, overlapping ventral scutes which provide maximum contact with the ground during locomotion. Such features are either reduced or absent in burrowing and aquatic species. Basically, terrestrial snakes exhibit four major kinds of locomotion, or combinations thereof. The most commonly used method is lateral undulation in which the body is moved through a series of horizontal curves, pushing against irregularities in the ground at various points. Most snakes in British Columbia use mainly this kind of movement. Rectilinear movement is used by heavy bodied species, such as the Western Rattlesnake (*Crotalus viridis*), and results in a straight-line motion; it is caused by a forward motion of the ventral scutes, which anchor to the ground, followed by the remainder of the body. In concertina movement, used in tight places, part of the body is contracted into a series of tight curves, anchoring the body and allowing the anterior end to move forward. Sidewinding is a specialized kind of locomotion used mainly by snakes on unstable substrates such as sand. It consists of a series of lateral looping movements with only two points of the body in contact with the ground; the result is a forward and sideways movement of the body. In addition, sidewinding in desert snakes reduces contact with the hot

substrate and thus prevents overheating. It should be noted that many species of snakes can sidewind, not just desert snakes, and that few species rely on just one means of locomotion.

Most snakes can swim and some are able to make prolonged dives. Surface swimming is usually accomplished by lateral undulation. Extremely aquatic snakes, such as sea snakes, are aided in propulsion by a laterally flattened tail and in diving by valvular nostrils.

Feeding

The main senses used by snakes in feeding are vision, smell, and heat detection. All snakes are carnivores and eat their prey whole, but a variety of feeding mechanisms exists. The simplest is probably the most common: the prey animal is simply grabbed, usually by the head, and swallowed alive. This method is generally used by the various species of garter snakes. Heavier bodied snakes may also swallow their food alive but subdue it by pressing down on it with the weight of the body. In some cases, this use of the body may cause the prey to be killed. From the snake's point of view, it is advantageous to kill the prey before eating it to reduce the risk of being injured by the prey and to facilitate the process of swallowing.

The most common methods of killing prey are by constriction and by envenomation. Constriction consists of striking the prey and wrapping a few loops of the body around it, forming a coil. Each time the prey exhales, the coil is tightened, and the prey dies of suffocation, not because its bones are crushed. Constrictors are necessarily well-muscled and most feed mainly on birds and mammals. Among species in British Columbia, the Rubber Boa and Gopher Snake kill by constriction.

Venomous snakes run the least risk of being injured by their prey since they inject their victims with venom through modified teeth called fangs, and then wait for their victims to die. Many venomous species are known, all with somewhat different kinds of venoms. All venoms are chemically very complex; some mainly affect the nervous system (e.g., cobra venoms), while others mainly affect the circulatory system and cause local tissue destruction (e.g., rattlesnake venoms). Most venoms, however, have a wide variety of effects. In addition to killing the prey, an important function of envenomation may be to speed up digestion since snakes cannot chew their food to expose a large surface area to digestive juices.

The most primitive venomous snakes are called rear-fanged snakes because their fangs are at the back of the mouth. The Night Snake (*Hypsiglena torquata*) is the only example of this type of snake in British Columbia. The venom injection apparatus in rear-fanged snakes is somewhat inefficient because the fangs are simply grooved, allowing venom to be lost, and because the prey has to be taken well into the mouth to be killed. A "chewing" motion may be used to envenomate the prey. The more highly evolved venomous snakes have fangs in the form of closed canals (like hypodermic needles) and can inject venom deep into the victim's body with one quick strike. These snakes fall into two major groups. The cobra and sea snake group has fairly short fangs right at the front of the mouth. The vipers and pit vipers (so-called because of the thermosensory pits on the head) also have fangs at the front of the mouth, but in this case the fangs appear to have evolved from rear fangs, with a concomitant shortening of the upper jaw and loss of anterior teeth. The fangs of vipers and pit vipers are very long and are folded back against the roof of the mouth when not in use. The Western Rattlesnake is British Columbia's only pit viper.

In all venomous snakes, the venom is produced in a modified salivary gland above the angle of the jaw. A duct connects the venom gland and fang on each side. As might be expected, the venom apparatus is used as a defence against intruders. Snakes in general defend themselves by biting if unable to escape. Other behaviours associated with defence in various species include hissing, vibrating of the tail, voiding of the scent glands at the base of the tail, playing dead, spreading a hood, and rolling into a ball. Most of these behaviours are exhibited by one or more species native to British Columbia.

Apart from fangs, most snakes have many other teeth in their mouths. A genus of African egg-eating snakes (*Dasypeltis*) has few teeth, which are also small (occasional egg-eating is practised by several species but *Dasypeltis* is highly specialized morphilogically for this habit). The teeth of snakes are usually fairly short, sharp, and curved backwards to prevent prey from slipping out of the mouth. Snakes can handle very large food items. This is mainly due to the highly kinetic nature of their skulls. In particular, the two halves of the lower jaw can be stretched apart and the two sides of both upper and lower jaws moved independently. Snakes swallow their prey essentially by "walking" the four quadrants of the jaws over the prey. The elastic nature of the skin also aids in handling of large prey. Finally, the windpipe opens into the floor of the mouth, permitting the snake to breathe during the often lengthy process of swallowing food.

How to Find Snakes

Although some species of snakes may be seen abroad and active during daylight (e.g., garter snakes, Racer), many are secretive and or nocturnal (e.g., Rubber Boa). Snakes can frequently be found most easily by turning over rocks, logs, and other cover objects. As in all such cases, the cover object should be put back in its original position after checking under it, because many organisms rely on the microhabitats provided by such cover. Of course, where venomous snakes occur, cover should be turned over with care, preferably with some sort of tool rather than with the bare hands. Harmless snakes in British Columbia can be caught by hand, although considerable speed may be required to capture the Racer. Specialized tools are used to capture poisonous snakes, but we strongly recommend that amateurs do not collect such animals. The consequences of poisonous snake bite are serious (see description of Western Rattlesnake on page 89). The most commonly used tools for handling venomous snakes are hooks and tongs. Both have long handles and can be used for lifting snakes into a container at a safe distance from the collector. In addition, the snake hook can be used to pin the snake's head to the ground, allowing the collector to grasp the snake by the back of the head.

Keys to the Snakes of British Columbia

Since one quite poisonous species of snake occurs in British Columbia, it is useful to have a key which does not require actual handling of the snake. On the other hand, it is sometimes necessary to make a more detailed examination of the snake to identify it correctly. Consequently, two keys are provided here, one for the field, the other for specimens in the laboratory.

Field Key to the Snakes of British Columbia

1a. Button or rattle on end of tail; body with a series of dark blotches down back, but sometimes dark overall; head large and triangular *Western Rattlesnake* (***Crotalus viridis***)

1b. No button or rattle on end of tail — 2

2a. Series of blotches down back — 3

2b. No blotches down back — 5

3a. Dorsal blotches often paired, only somewhat larger than those on side; three distinct dark brown blotches on back of neck; pupil of eye vertically elliptical *Night Snake* (***Hypsiglena torquata***)

3b. Dorsal blotches single and substantially larger than those on side — 4

4a. Blotches dark brown against yellowish background *Gopher Snake* (***Pituophis melanoleucus***)

4b. Blotches brownish against blue-grey background; small snake *Racer* (***Coluber constrictor***)

5a. Dorsal colour uniform brown or grey-blue; skin usually fairly shiny (smooth scutes) — 6

5b. Dorsal colour not as in 5a — 7

6a. Dorsal colour uniform brown; body short and stout with blunt head and tail *Rubber Boa* (***Charina bottae***)

6b. Dorsal colour uniform grey-blue; body long and slender, well-defined head and long whiplike tail *Racer* (***Coluber constrictor***)

7a. Longitudinal mid-dorsal stripe along back — 8

7b. No stripe down back — 9

8a. Mid-dorsal stripe straight sided and bright yellow; background black, often with red blotches on side of body *Common Garter Snake* (***Thamnophis sirtalis***)

Field Key—Continued

8b. Colouration different from 8a 10

9a. Dorsal surface brown with slight checkering, or uniform black, not shiny; possibly with red blotches on ventral surface *Northwestern Garter Snake* ***(Thamnophis ordinoides)***

9b. Dorsal colour greyish, yellow-brown, or reddish-brown, usually with a wide yellowish or reddish stripe along each side; tail blunt with sharp, pointed scute at tip *Sharptail Snake* ***(Contia tenuis)***

10a. Dorsal background colour brown with yellowish mid-dorsal stripe (stripe often faint) or black with red mid-dorsal stripe (stripe often incomplete or broken); possibly with red blotches on ventral surface *Northwestern Garter Snake* ***(Thamnophis ordinoides)***

10b. Mid-dorsal stripe usually in zigzag form, often two rows of alternating dark blotches on sides of body; sometimes bluish all over *Western Terrestrial Garter Snake* ***(Thamnophis elegans)***

Laboratory Key to the Snakes of British Columbia

1a. Body scutes all keeled 2

1b. Some or all of body scutes smooth 5

2a. Pit or cavity on side of head between nostril and eye; button or rattle on end of tail *Western Rattlesnake* ***(Crotalus viridis)***

2b. No pit or rattle 3

3a. 17 rows of body scutes at mid-body *Northwestern Garter Snake* ***(Thamnophis ordinoides)***

3b. More than 17 rows of body scutes at mid-body 4

4a. 19 rows of body scutes at mid-body *Common Garter Snake* ***(Thamnophis sirtalis)***

4b. 21 rows of body scutes at mid-body *Western Terrestrial Snake* ***(Thamnophis elegans)***

5a. Scutes on back slightly keeled, all other body scutes smooth; series of dark brown blotches down back; dark line across head in front of eyes plus a dark band from eye to angle of jaw *Gopher Snake* ***(Pituophis melanoleucus)***

5b. All body scutes smooth 6

Laboratory Key—Continued

6a. Head and tip of tail blunt; 44-45 rows of body scutes at mid-body *Rubber Boa* ***(Charina bottae)***

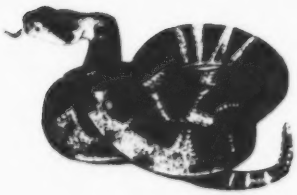
6b. Fewer than 44 rows of body scutes at mid-body 7

7a. 21 rows of body scutes at mid-body; yellow-grey background with numerous brown blotches, the mid-dorsal row often occurring in pairs; 3 dark brown blotches on back of neck; pupil of eye vertically elliptical *Night Snake* ***(Hypsiglena torquata)***

7b. Fewer than 21 rows of body scutes at mid-body 8

8a. 15 rows of body scutes at mid-body; tail blunt with sharp, pointed scute at tip; usually a yellowish or reddish stripe along each side *Sharptail Snake* ***(Contia tenuis)***

8b. 15–17 rows of body scutes at mid-body; head large with large eyes, tail long and whip-like; dorsal colour grey-blue, although small specimens may have series of large blotches down back *Racer* ***(Coluber constrictor)***



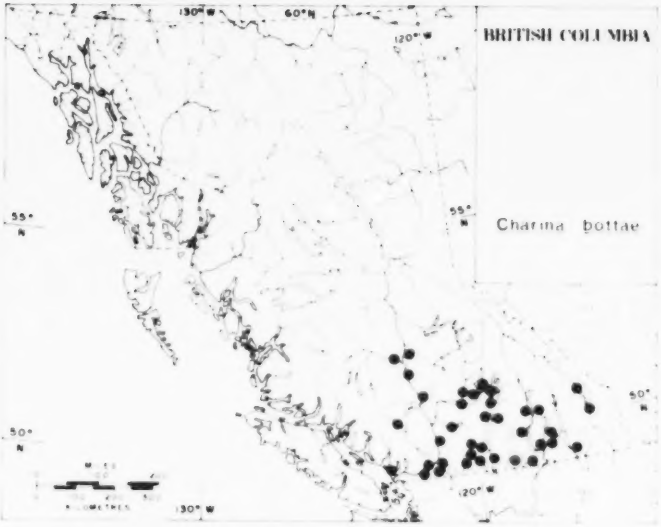
THE FAMILY BOIDAE—BOAS

Rubber Boa ***Charina bottae*** (Blainville)

Description—Body short and stout with short, blunt, prehensile tail. Adult length 355–725 mm. Head rounded, blunt, and not distinct from neck. Eye small, with vertical pupil. Plates on top of head large and irregular; body scutes small and smooth. Anal plate single with a small spur (vestigial hind limb) in pit on either side; spur more conspicuous in males; may even be absent in females. Subcaudal scutes single. Dorsal surface uniformly brown, greyish or yellowish or greenish-brown. Ventral surface yellow.

Habits and Habitat—The common name of the Rubber Boa is derived from its rather plasticine-like appearance. It is an extremely sluggish and inoffensive snake. Often, when alarmed, the Rubber Boa may roll itself into a ball with its head in the centre and the tail sticking out. Because the tail mimics the head in appearance, this behaviour may have the effect of diverting the attention of a predator from the head to the

Rubber Boa



less-vulnerable tail. Because of the similarity of head and tail, the Rubber Boa is frequently referred to as the "two-headed" snake.

The Rubber Boa appears to be primarily a snake of humid, mountainous regions, although it also occurs in drier, lowland localities. It is apparently a burrowing species and has, as an adaptation to this way of life, a much more solid skull than do other snakes which occur in British Columbia. In general, the Rubber Boa is a secretive snake and not often seen. Since this species is highly nocturnal, it is sometimes encountered late at night when it may be seen on roads. The Rubber Boa appears to be one of our most cold-tolerant snake species.

The Rubber Boa kills its food by constriction (i.e., by causing suffocation) as do the larger, tropical members of its family. The major component of its diet appears to be small mammals, although birds and lizards are also sometimes taken. Little is known about the food habits of this species in the wild; however, captive specimens eat a wide variety of food, including fish and small snakes.

This species bears live young; litter size ranges from two to eight, and newborn young range from 180–280 mm in length. Almost nothing else is known about its breeding habits. Possibly, the male makes use of his spurs in courtship and mating, as has been observed in other boas.

Subspecies—None are currently recognized.

Range and Distribution—From British Columbia south to the San Bernardino Mountains in California and east to western Montana, western Wyoming, and Utah. In British Columbia, the Rubber Boa is found across the southern part of the province, as far north as Quesnel. An early record for Vancouver Island is of doubtful validity.

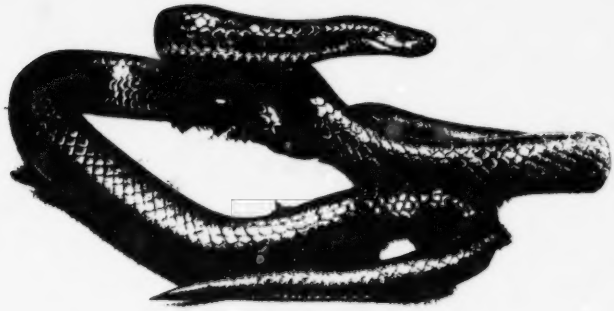
THE FAMILY COLUBRIDAE—HARMLESS SNAKES

Sharptail Snake *Contia tenuis* (Baird and Girard)

Description—Body short but fairly stout; tail short and tapering and ending in a sharply pointed scute. Adult length 205–455 mm. Head wider than neck and with broad, rounded snout. Eye small with round pupil. Body scutes smooth and anal plate double. Ground colour greyish, yellowish-brown, or reddish-brown (tending to be reddish on tail), sometimes with fine dots of black or slate and usually with a wide yellowish or reddish stripe along each side. Scutes below stripe dotted with black or darkened to form a continuous band in young individuals. Ventral surface whitish, greyish, or yellowish with conspicuous transverse dark bar on anterior edge of each plate. Top of head dark brown, chin light.

The distinctive pointed tail and conspicuous ladder-like markings on the ventral surface serve to distinguish the Sharptail Snake from all other snake species in British Columbia.

Habits and Habitat—This species may be rare in British Columbia; fewer than ten specimens have been found. However, the Sharptail Snake is very secretive; therefore its status is difficult to assess. Sightings of this species should be reported to the British Columbia Provincial Museum. Little is known about the natural history of this snake. Apparently the Sharptail Snake is found in woodlands and forests, especially near



Sharptail Snake

streams. It seems to be partial to moist environments and is possibly nocturnal. The diet is reported to consist mainly of slugs. The function of the pointed tail is not known; it is apparently sometimes used to help push the body forward when the snake is climbing an incline. The Sharptail Snake is quite tolerant of cold and has a tendency to gather in large groups.

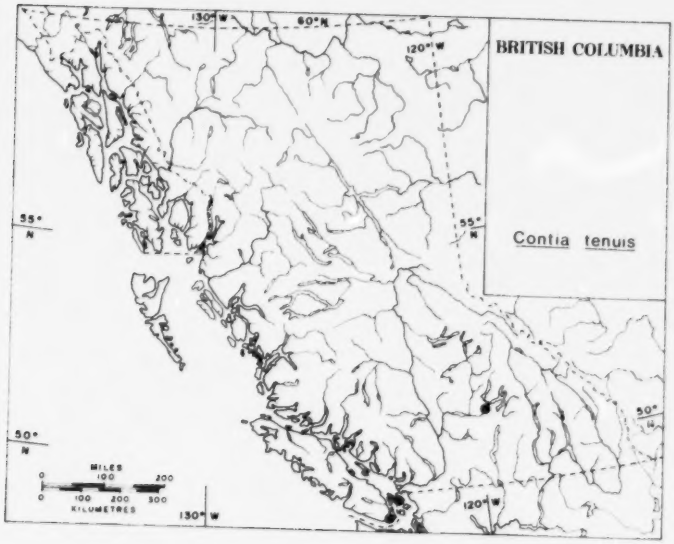
Nothing is known about the breeding habits of the Sharptail Snake except that it is an egg-layer (two to nine eggs per clutch) and that the young are about 75 mm long when they hatch.

Subspecies—None are recognized.

Range and Distribution—Occurs spottily in British Columbia and Washington. The main, continuous, part of its range extends from western Oregon south to central California.

In British Columbia, the Sharptail Snake is known mostly from North and South Pender Islands in the Gulf Islands, although two specimens were caught near Chase in the Interior in 1964. One specimen, collected in the 1800's, has its locality noted as Vancouver Island and two more

specimens have recently been found at Metchosin on Vancouver Island. It is not clear whether this distribution is due simply to the secretive nature of the snake and the resulting scarcity of recorded specimens or to the fact that the British Columbia populations are relicts of a wider range in the past. However, it seems likely that the Sharptail Snake is more widely distributed in the Vancouver Island-Gulf Island areas; sightings should be reported to the British Columbia Provincial Museum.

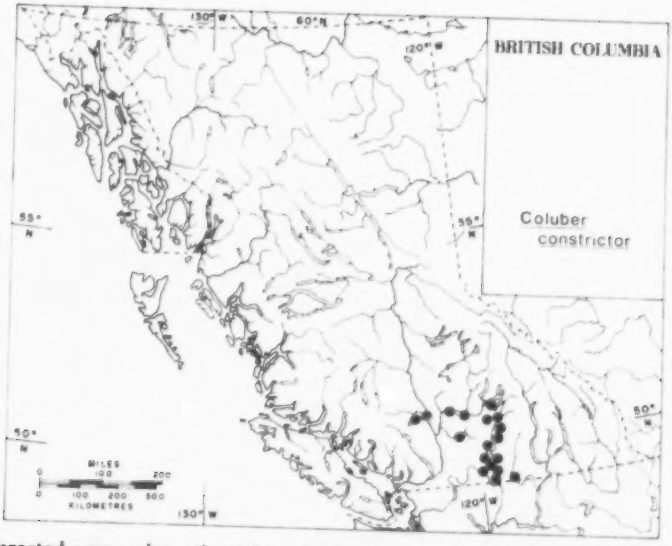


Racer ***Coluber constrictor*** (Linnaeus)

Description—Body long and slender with long, whip-like tail. Adult length 560–1 980 mm. Head large and distinct from neck. Eye large with round pupil. Body scutes smooth and anal plate divided. Adult dorsal colour uniform greyish or olive, becoming greenish or bluish on lower sides; skin between scales often black. Ventral colour yellow. The young are similar but with series of 70–85 brown "saddles" or cross-bands along back and smaller blotches on sides. These markings become progressively fainter as the snake grows and have usually disappeared by the time it reaches about 610 mm in length.

Habits and Habitat—The Racer is a widespread species whose common name reflects its agility and speed. Although usually abundant where found, it is often difficult to catch. Individuals are often aggressive and strike readily, sometimes vibrating the tail as well. The Racer is a large, active predator which commonly moves with its head well off the ground. This snake is generally active during daylight and is probably the most heat-tolerant species of snake in British Columbia. The Racer is also an able climber and is sometimes found in bushes. Its usual habitat is open, sparsely treed country, but Racers may pass the winter in more

Racer



forested areas where they share hibernating dens with rattlesnakes, gopher snakes, and garter snakes.

The diet of the Racer is extremely varied; frogs, lizards, other snakes, small mammals, birds, and insects are all taken. Small mammals and insects, however, are probably the most important foods. Despite its scientific name, the Racer does not constrict its prey but may simply pin the prey down with its body while feeding. This species is an egg layer, clutch size ranging from three to 40. The eggs usually measure 24–39 mm in length and 14–21 mm in width. At hatching, the young range from 205 to 305 mm in length.

Subspecies—At least eight are recognized: Only the Western Yellowbelly Racer (*C. c. mormon*) occurs in British Columbia.

Range and Distribution—Occurs over most of the United States and adjacent parts of southern Canada. It is absent from the southwestern United States and the northern Mississippi River area.

In British Columbia, the Racer is restricted to the interior Dry Belt, especially in the area bounded by the Okanagan, Similkameen, Fraser, and Thompson Valleys.

Gopher Snake ***Pituophis melanoleucus*** (Daudin)

Description—Body long and stout; tail moderately long. Adult length 915–2 500 mm. Head slightly larger than neck; snout narrow and projecting beyond lower jaw. Eye large with round pupil. Scutes on back lightly keeled, those on sides smooth. Anal plate is single. Dorsal ground colour usually pale yellow or greyish-yellow; keels on scutes are dark brown. Superimposed on this is a series of 45–55 dark brown blotches along the back beginning behind the head; on the upper surface of the tail, these become a series of 12–16 dark brown cross-bands. In addition, there are several series of smaller blotches or spots along the body sides. Also a dark line across the head in front of the eyes, a dark band from the eye to the angle of the jaw, and a dark vertical spot below the eye. Ventral surface yellow or yellowish-white with brown or black spots.

Habits and Habitat—The Gopher Snake is found in a wide variety of situations from forested areas to open sagebrush. It is a good climber. In winter, Gopher Snakes often share communal dens with rattlesnakes and other snake species. There is no truth, however, to the beliefs that Gopher Snakes lead rattlesnakes to dens, that they commonly eat rattlesnakes, or that they interbreed with rattlesnakes.

Gopher Snake

The Gopher Snake is a large, aggressive snake, often striking readily. In addition to active striking, Gopher Snakes usually hiss loudly when aroused. Because of their aggressiveness and hissing behaviour, Gopher Snakes are also sometimes called bull snakes. Loud hissing is made possible by a modification of the epiglottis into an erect and flexible structure which vibrates in the stream of air forced from the windpipe. The hiss can be pulsed to produce a sound like that of a rattlesnake rattling. Finally, the Gopher Snake may rapidly vibrate its tail when disturbed. If the snake is sitting in loose debris when it does this, the sound is similar to that of a rattlesnake rattling. These behaviours, together with a superficial resemblance to a rattlesnake, sometimes result in the Gopher Snake being slain as a dangerous animal.

Gopher Snakes are mostly crepuscular, but are occasionally seen at all times of day or night. They are economically important animals because they prey heavily on small mammals, some of which may be major crop pests. Birds and their eggs are also sometimes taken. Prey is usually killed by constriction.

The Gopher Snake lays eggs, clutch size ranging from three to 24. Young measure 204–455 mm in length at hatching. Mating behaviour has been described in some detail for this species and is readily observed in captivity. Typically, as in most snakes, the male lines his body along and on top of that of the female. In addition, however, the male usually grasps the female on the back and neck, apparently stimulating her. Two male Gopher Snakes may sometimes engage in this kind of activity. In such cases, the behaviour is referred to as a "combat dance" but may not be related to disputes over mates.

Subspecies—About ten are recognized, of which two occur in British Columbia. In the Pacific Gopher Snake (*P. m. catenifer*), the anterior dorsal blotches are separated from one another and from the secondary blotches on the side of the neck; in the Great Basin Gopher Snake (*P. m. deserticola*), these blotches are usually connected with one another and with the secondary blotches to form a longitudinal stripe on the side of the neck.

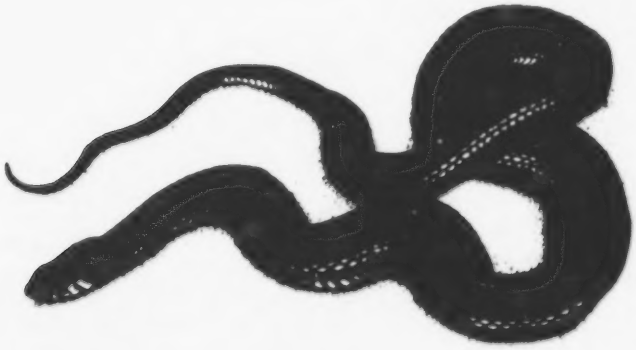
Range and Distribution—Widely distributed over most of western United States and parts of adjacent Canada. Also found in southeastern United States.

In British Columbia, the subspecies *catenifer* is probably a relict, a single specimen having been taken from Galiano Island. Another specimen, however, was collected in the 1800's at Sumas, Washington, on the Canadian border. The subspecies *deserticola* is confined to the interior Dry Belt in British Columbia.

Common Garter Snake ***Thamnophis sirtalis*** Linnaeus

Description—Body long and slender; tail moderately long. Adult length 494–1 295 mm. Head large and distinct from neck. Eye large with round pupil; one preocular. Usually seven upper labials and ten lower labials. Often a red or dark blotch on posterior upper labials. Body scutes strongly keeled with 19 rows at mid-body. Anal plate single. Ground colour usually black or dark brown; skin between scutes usually red producing series of red vertical bars or blotches on sides of body (red sometimes absent on Vancouver Island specimens). Three yellow or greenish-yellow stripes running length of body; mid-dorsal stripe includes middle row of scales and part of row of body scutes on each side. Top of head usually uniform black, brown or olive-green; upper lip yellow. Posterior part of head often marked by considerable red, laterally (less so on Vancouver Island specimens). Ventral surface varies from yellow to black; chin and throat usually pale yellow.

Habits and Habitat—This is the most widespread species of snake in North America. In the northernmost parts of its range it is the only snake



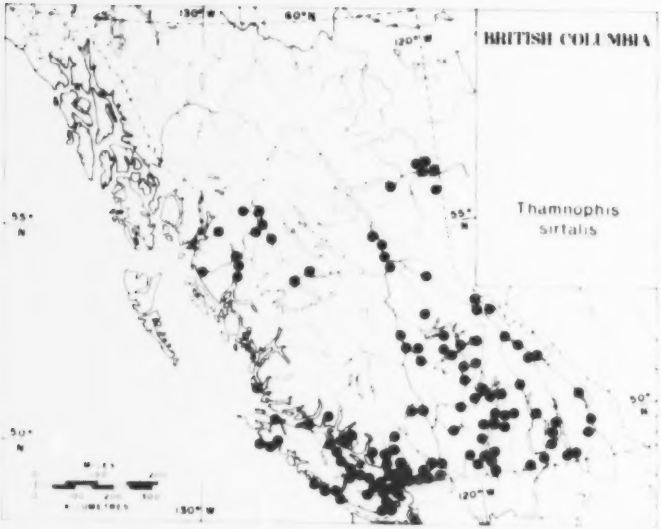
Common Garter Snake

present. The Common Garter Snake is more cold-tolerant than most other snakes and is sometimes found in relatively cool habitats.

The Common Garter Snake lives in a wide variety of environments, including some cities, but is most abundant near marshes, small lakes, rivers and ponds, and fairly humid forests. This selection of habitats appears to be related to the availability of its major prey, amphibians and earthworms, which are eaten alive. Other kinds of food such as intertidal and fresh-water fishes, leeches, and small birds are sometimes taken. When captured, these snakes sometimes bite, but more often simply emit excrement and foul-smelling fluid from the cloacal glands.

The Common Garter Snake is live-bearing, producing two to 85 young in mid- to late summer. Newborn young average about 200 mm in length. Mating usually takes place in spring, following emergence from hibernation, but occasionally occurs in fall. Courtship, as in many species of snakes, involves attraction of the male to the female by odour, and stimulation of the female by physical contact along the length of the body. Snake "balls" are often formed in this species. In such cases, several males may simultaneously court the same female, but probably only one male is successful in mating the female. Communal over-wintering of large numbers of individuals is well documented in this species, especially in the northern parts of its range including northern British Columbia.

Subspecies—11 are recognized. Three of these occur in British Columbia. The Valley Garter Snake (*T. s. fitchi*) has a slaty or brownish ground colour, a broad dorsal stripe with well-defined borders, and prominent red bars on the side of the body; the top of the head is black while the sides of the head are red. The Red-sided Garter Snake (*T. s. parietalis*) also has prominent red bars on the side of the body, and the top of the head is usually olive. The Puget Sound Garter Snake (*T. s. pickeringi*) has a relatively narrow dorsal stripe, confined mostly to the mid-dorsal row of scutes, and the red bars on the side of the body are often reduced or absent, especially on Vancouver Island specimens; the top of the head is usually black. In practice, however, these colour variations may occur to some extent in all three subspecies and the three may be difficult to tell apart. If in doubt as to identification, location of capture may be the most useful clue.

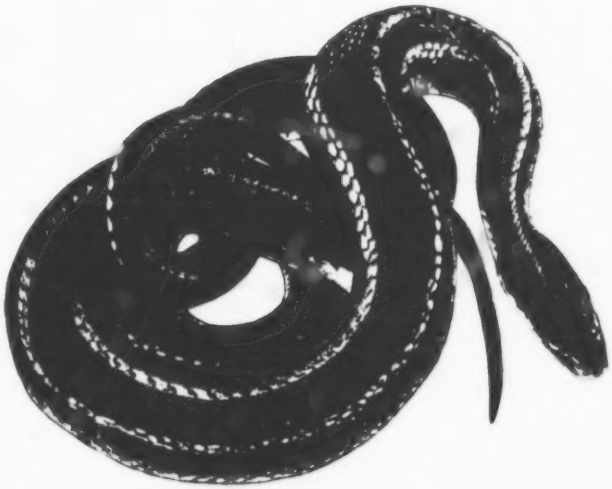


Range and Distribution—The most widespread snake in North America, ranging from the Atlantic to the Pacific oceans and from the Gulf of Mexico to Fort Smith in the Northwest Territories. Absent from southwestern United States.

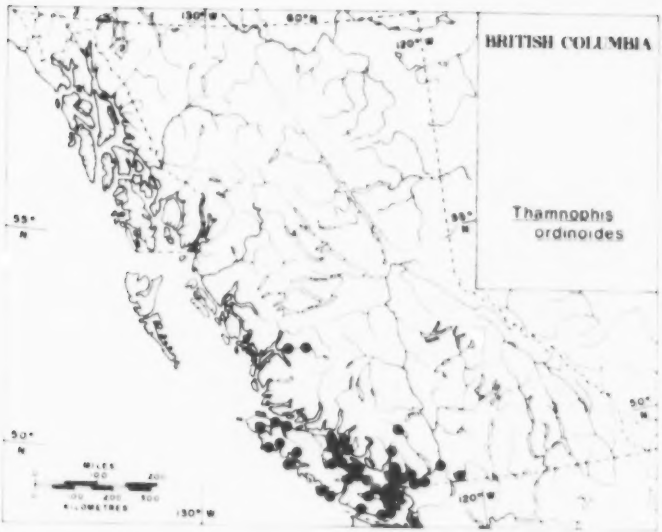
In British Columbia, *pickeringi* is restricted to Vancouver Island and the immediately adjacent mainland coast, *fitchi* occupies the great bulk of the province south from 120 miles north of Prince Rupert, and *parietalis* occurs along the eastern side of the province from the Peace River district south.

Northwestern Garter Snake ***Thamnophis ordinoides*** (Baird and Girard)

Description—Body long and fairly stout; tail moderately long. Adult length 355–660 mm. Head small, fairly blunt in snout, and not very distinct from neck. Eye small with round pupil; one or two preoculars. Usually seven upper labials and eight or nine lower labials. Body scutes strongly keeled and in 17 rows at mid-body. Anal plate single. Colour and pattern extremely variable. "Typical" specimens have a yellow dorsal stripe and a yellow lateral stripe (on 2nd and 3rd rows of body scales) on each side, running length of body; ground colour brown with two rows of small black blotches between stripes, top of head brown, upper lip white, chin and ventral surface white. Any or all of these features, however, may vary. Some specimens may lack dorsal and/or lateral stripes; stripes may also be incomplete. Many specimens show considerable red: Sides of body may be reddish, dorsal stripe may be red, and ventral surface is commonly blotched with red. Dark or completely black (melanistic)



Northwestern Garter Snake



specimens are fairly common. Sometimes, specimens will be completely black (including eyes) save for a bright red dorsal stripe and/or belly. Albino (white) specimens are known.

Unless body scutes are examined, this species is probably best identified by elimination. All of our other snake species are much less variable and easier to identify. The best characters to use for *T. ordinoides* are the white upper lip (even this may vary sometimes) and the small, blunt-nosed head. Also, snakes with red dorsal stripes and/or red ventral surfaces (in British Columbia) are almost certain to belong to this species.

Habits and Habitats—This species is a highly terrestrial snake and is particularly common in open areas such as meadows and along the edges of forests. The Northwestern Garter Snake also may inhabit the forests themselves and may be found along estuaries and on beaches on the coast. Although sometimes found near water this snake does not often enter the water.

The Northwestern Garter Snake is often the most common snake where it occurs in British Columbia. It is inoffensive, rarely biting when captured (although it will often emit strong-smelling fluid from the cloacal glands when handled). The diet reflects the relatively sedentary behaviour of this species, consisting almost exclusively of slugs and earthworms. In California, salamanders and frogs have been recorded as occasional food items of the Northwestern Garter Snake.

Thamnophis ordinoides is live-bearing. Birth occurs in mid- to late summer with litter size varying from two to 19. Young snakes measure 145–200 mm at birth. Mating has been observed to take place in both fall and spring.

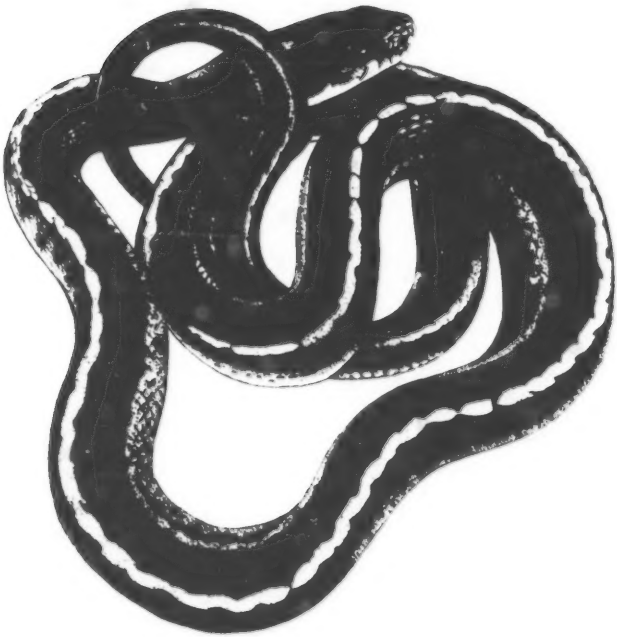
Subspecies—None are recognized.

Range and Distribution—Coastal British Columbia, western Washington and Oregon, and extreme northwestern California.

Found along the coast of southwestern British Columbia, including the Gulf Islands and all of Vancouver Island, and inland to Manning Park.

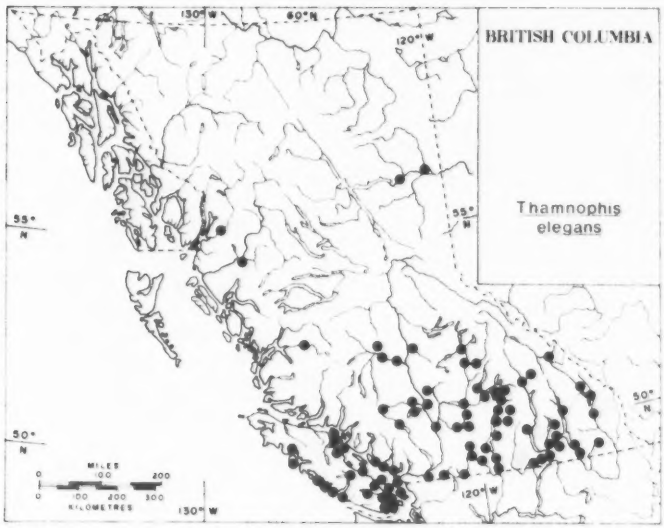
Western Terrestrial Garter Snake — *Thamnophis elegans* (Baird and Girard)

Description—Body fairly long and robust; tail moderately long. Adult length 455–1 065 mm. Head large and distinct from neck. Eye moderately large with round pupil. Preocular usually single on coast, double east of Coast Range. Usually eight upper labials and ten lower labials (sometimes seven or nine respectively); posterior upper labials very large relative to other garter snakes. Body scutes strongly keeled with 21 rows at mid-body. Anal plate single. Ground colour usually grey, black, to dark brown, on Vancouver Island, and lighter brown elsewhere in British Columbia. Prominent yellow to orange mid-dorsal stripe along length of back, usually a wavy line but sometimes straight; yellow lateral lines running length of body (on 2nd and 3rd rows of body scutes) less evident than mid-dorsal stripe. Two rows of dark brown or black blotches between stripes on each side of body (upper row invades mid-dorsal stripe giving it its wavy appearance); blotches particularly obvious in Interior specimens but may not show clearly in coast specimens. Series of small



Western Terrestrial Garter Snake

dark brown or black spots below lateral stripe (or even invading lateral stripe). Rarely, specimens have tinge of red on sides of body. Top of head black or brownish with black markings in coast specimens, brown in Interior specimens; upper lip white or yellow. Ventral surface usually greyish, sometimes with black markings; chin and throat whitish. Some coast specimens may have a generally bluish appearance with otherwise normal pattern.



Habits and Habitat—Despite its common name, "Terrestrial", in British Columbia *Thamnophis elegans* is an aquatic snake rarely found far from water, both fresh and marine. It is also rarely found in forested areas, apparently preferring open situations such as meadows and estuaries. Despite this habitat restriction, however, this garter snake has one of the most varied diets of any of our native snakes feeding mainly on slugs, small mammals, and fish. Both fresh-water and marine fish are taken in coastal areas; in some locations intertidal fish may make up almost the entire food intake. Other food items such as amphibians, earthworms, leeches, birds, and other snakes are also eaten fairly frequently. Interestingly, this species may handle adult rodents by coiling its body around the prey much in the manner of constricting snakes. This behaviour is probably not actual constriction but seems to be simply a method of restraining potentially dangerous prey. No other garter snakes are known to do this.

The Western Terrestrial Garter Snake is a very active, aggressive animal and will often bite when captured. Like many other snakes, it will also often emit a foul-smelling liquid from its cloacal glands when captured.

This species is live-bearing, producing one to 17 young in mid- to late summer. Newborn young measure 171–230 mm in length. Mating takes place in spring.

Subspecies—Four are recognized: Only the Wandering Garter Snake (*T. e. vagrans*) occurs in British Columbia.

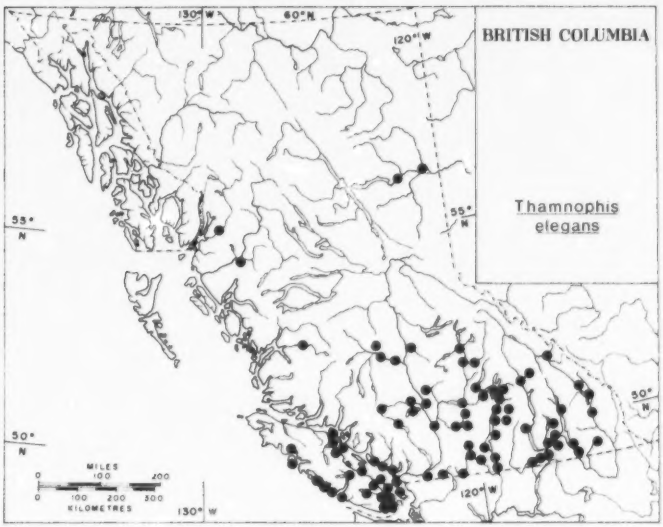
Range and Distribution—From southern British Columbia and Alberta, and southwestern Saskatchewan, south to central New Mexico and west to central California with only a few gaps in its distribution.

In British Columbia, the Wandering Garter Snake is found throughout the southern part of the province from the coast, including Vancouver Island, to the Alberta border and as far north as the Peace River district.

Night Snake ***Hypsiglena torquata*** (Gunther)

Description—A small snake with a slender body; adult length 305–500 mm. Head somewhat flat and slightly triangular; pupil of eye vertical. Body scutes smooth and arranged in 21 rows at mid-body (19 rows in one subspecies outside our area); anal plate divided and subcaudal scutes in two rows. Dorsal surface with grey or yellowish-brown background and numerous darker grey-brown spots; a mid-dorsal row of more or less paired blotches with an alternating row of smaller blotches on each side and a second row of still smaller spots low on each side. Three distinct dark brown blotches on back of neck, middle one widened posteriorly to cover most of nape; much variation in configuration of these blotches, sometimes being connected and sometimes not. Upper labials whitish; a dark brown bar behind eye, running backward and downward, with a narrower bar running forward in front of eye. Ventral surface white or yellowish with no pattern.

Habits and Habitat—The Night Snake is a secretive, nocturnal snake, whose life cycle in not well known. In some parts of its range it is



Habits and Habitat—Despite its common name, "Terrestrial", in British Columbia *Thamnophis elegans* is an aquatic snake rarely found far from water, both fresh and marine. It is also rarely found in forested areas, apparently preferring open situations such as meadows and estuaries. Despite this habitat restriction, however, this garter snake has one of the most varied diets of any of our native snakes feeding mainly on slugs, small mammals, and fish. Both fresh-water and marine fish are taken in coastal areas; in some locations intertidal fish may make up almost the entire food intake. Other food items such as amphibians, earthworms, leeches, birds, and other snakes are also eaten fairly frequently. Interestingly, this species may handle adult rodents by coiling its body around the prey much in the manner of constricting snakes. This behaviour is probably not actual constriction but seems to be simply a method of restraining potentially dangerous prey. No other garter snakes are known to do this.

The Western Terrestrial Garter Snake is a very active, aggressive animal and will often bite when captured. Like many other snakes, it will also often emit a foul-smelling liquid from its cloacal glands when captured.

This species is live-bearing, producing one to 17 young in mid- to late summer. Newborn young measure 171–230 mm in length. Mating takes place in spring.

Subspecies—Four are recognized: Only the Wandering Garter Snake (*T. e. vagrans*) occurs in British Columbia.

Range and Distribution—From southern British Columbia and Alberta, and southwestern Saskatchewan, south to central New Mexico and west to central California with only a few gaps in its distribution.

In British Columbia, the Wandering Garter Snake is found throughout the southern part of the province from the coast, including Vancouver Island, to the Alberta border and as far north as the Peace River district.

Night Snake ***Hypsiglena torquata*** (Gunther)

Description—A small snake with a slender body; adult length 305–500 mm. Head somewhat flat and slightly triangular; pupil of eye vertical. Body scutes smooth and arranged in 21 rows at mid-body (19 rows in one subspecies outside our area); anal plate divided and subcaudal scutes in two rows. Dorsal surface with grey or yellowish-brown background and numerous darker grey-brown spots; a mid-dorsal row of more or less paired blotches with an alternating row of smaller blotches on each side and a second row of still smaller spots low on each side. Three distinct dark brown blotches on back of neck, middle one widened posteriorly to cover most of nape; much variation in configuration of these blotches, sometimes being connected and sometimes not. Upper labials whitish; a dark brown bar behind eye, running backward and downward, with a narrower bar running forward in front of eye. Ventral surface white or yellowish with no pattern.

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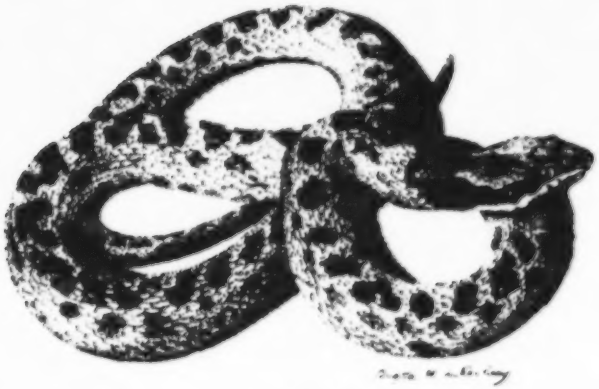


Night Snake

abundant but rarely seen. During the day, it is usually found under rocks or other cover, but may be seen crossing roads at night when it forages for prey. This species occurs in a variety of habitats but is generally associated with arid regions, especially sandy and rocky habitats. It is probably rare in British Columbia; however, since it might easily be confused at first glance with small individuals of other blotched snakes (bullsnakes, rattlesnakes, juvenile racers), care should be taken in identifying and handling doubtful specimens.

The Night Snake is our only example of a rear-fanged venomous snake. The fangs are enlarged teeth at the back of the upper jaw and are only slightly grooved if at all. The saliva is toxic to the snake's usual prey, mainly small lizards and frogs, and is conducted into the prey along the fangs, accompanied by a "chewing" motion. This venom apparently paralyses small lizards within seconds, although much more time may be required for death to occur. Small frogs may simply be swallowed whole and alive. The venom is not known to be dangerous to man, unlike that of some large rear-fanged snakes in other parts of the world. In any case, the Night Snake is small and rarely, if ever, attempts to bite when handled.

This species lays eggs; the young are 150–180 mm long at hatching.

Subspecies—Several are recognized, of which six occur in North America. The subspecies known from British Columbia is *H. t. desertícola*, the Desert Night Snake.

Range and Distribution—From British Columbia, through central Washington, eastern Oregon, southern Idaho, Nevada, Utah, and across the southern United States from California to central Texas; south throughout Mexico and Central America to Costa Rica.

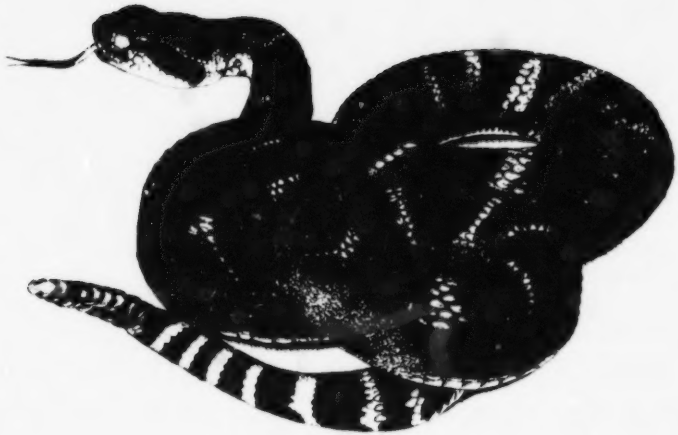
The Night Snake has been recorded only once in British Columbia, near Kaleden in the southern Okanagan Valley in 1980. Further sightings should definitely be reported to the British Columbia Provincial Museum in Victoria.

THE FAMILY VIPERIDAE—VIPERS

Western Rattlesnake ***Crotalus viridis*** (Rafinesque)

Description—Body long and stout; tail short, ending in horny rattle or button. Adult length 600–1 575 mm. Head broad (especially at back), triangular, and distinct from neck. Eye moderate in size with vertical pupil; two preoculars. Deep pit between eye and snout. Scutes on top of head small; body scutes strongly keeled. Anal plate single; subcaudal scutes single. Ground colour brown, tan, olive, or grey, with a series of large dark brown blotches along the back; these blotches typically have light-coloured edges and appear as cross-bands on the posterior part of the body and tail. A series of smaller blotches appears on each side of the body below the large blotches. Ground colour between bands may be somewhat lighter towards tail than on most of body. Juvenile rattlesnakes are usually lighter in colour and show a greater contrast of blotches with background than the adults. Top of the head usually shows ground colour with dark band running from below the eye to the corner of the jaw. Underparts yellowish-white, sometimes brownish.

Habits and Habitat—The rattlesnake is the only venomous species of snake occurring in British Columbia. The common name of rattlesnakes is derived from the rattle-like structure at the end of the tail. This rattle consists of a series of loosely interlocked horny segments (really modified and fused scutes) which produce a characteristic buzzing sound when



Western Rattlesnake

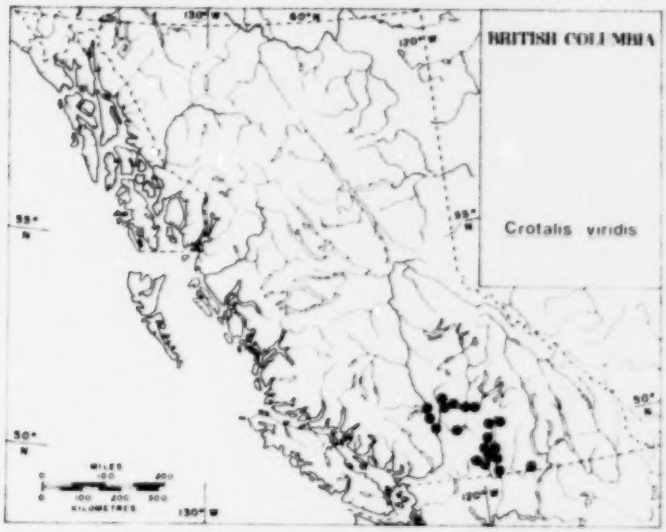
the tail is vibrated rapidly. The rattle's function is not clear, but rattlesnakes typically use it when disturbed; the rattle is probably used to warn intruders of the presence of the snake. In newborn rattlesnakes, the rattle consists of a single segment called a button. A new segment is added each time the snake sheds its skin, the button remaining at the tip. Snakes may shed their skins several times a year, depending on conditions. Since the number of sheddings per year may vary somewhat, the number of segments in a rattle does not give a very precise indication of the age of the snake. In addition, segments tend to be broken off as the rattle becomes longer, so that older rattlesnakes rarely have a complete rattle. Estimating ages, even roughly, is impossible for snakes with incomplete rattles.

The venom-injecting apparatus is believed to have evolved as a means of getting food without being injured by the prey and/or as a way of injecting digestive enzymes directly into the prey (i.e., to speed digestion of prey which are swallowed intact). The venom is produced in a gland above the angle of the jaw. Its chemical composition is complex, but it contains some components which destroy proteins and others which interfere with the nervous system. The fangs are two specialized teeth at

the front of the upper jaw. They are like small hypodermic needles and are used to inject the venom into the prey. A duct connects the fang with the venom gland and serves as a passageway for the venom. The fangs in rattlesnakes and related snakes are very long and, when not in use, are folded back along the roof of the mouth. As the snake strikes, the fangs are swung forward from their resting position. Typically, bites are very rapid and require less than a second. It is impossible to permanently "defang" a rattlesnake (unless the fang-bearing bones are removed) since replacement fangs are produced throughout the life of the snake. Often, an extra set of fangs will be present in the mouth ready to go into action if the current fangs are lost. It is also usually not possible to remove the venom glands without risk of infection or other injury to the snake. Some rattlesnakes may starve if they are unable to use their venom apparatus to obtain prey.

Obviously, rattlesnakes also use this venom apparatus for defence. The venom is quite dangerous to humans and rattlesnakes should not be treated lightly. This does not mean, however, that they should be mercilessly persecuted, as they are in some areas, for they are interesting animals and can easily be avoided if common sense is used. When in known rattlesnake habitat, always watch where you put your feet and hands. Wear long loose trousers to minimize the possibility of a serious bite on the leg (cloth tends to absorb some of the venom or may even prevent the fangs from reaching the skin). Rattlesnakes are generally not aggressive and usually bite only as a last resort or when suddenly startled (as when stepped on, for example).

The effect of snake bite on people depends on a number of factors: size of the person and the snake, health and other individual characteristics of the person, how recently the snake has fed (snakes which have recently eaten will obviously have less venom), and where on the body the bite has occurred. Bites directly into large blood vessels are particularly serious since the venom may then rapidly spread throughout the body. Although a bite may be dangerous to small children, few people die of snakebite anymore (bees and wasps account for many more fatalities in North America each year than do snakes), particularly if the victim receives prompt medical care. However, it should be noted that local tissue damage and disfigurement, paralysis, and amputation of bitten limbs are fairly common effects of rattlesnake bites. In all cases of snakebite, the



victim should be kept as calm and still as possible (to reduce blood circulation) and taken as rapidly as possible to the nearest hospital. Most hospitals in rattlesnake areas have a ready source of antivenin and have medical staff familiar with the treatment of snakebite. Some authorities feel that no first aid should be given to the victim unless he or she is bitten in an area far from a hospital. For such situations, "cutter" kits may provide the most useful and least dangerous first aid. Most such kits include a set of instructions.

The Western Rattlesnake is generally restricted to dry habitats where there is some shelter available in the summer. Talus slopes in sagebrush and lightly forested country are typically good places to find rattlesnakes. In winter, rock outcrops and talus slopes function as "dens" in which the snakes hibernate; generally, such locations provide easy access underground below the frost line. Rattlesnakes often hibernate in large groups of a hundred or more and share their dens with other species of snakes. They usually go into hibernation in late September and emerge again in

early April. In summer, rattlesnakes are probably mainly crepuscular, but may be found at any time of day or night.

Rattlesnakes feed mainly on small mammals and are probably important economically as controllers of rodent pests. The benefits rattlesnakes provide in this regard more than outweigh the relatively minor hazard they pose. Birds are also occasionally eaten.

The "pit", located between the eye and nostril (common to all pit vipers), functions as a heat-sensing organ and is used to detect the usual warm-blooded prey of the snake. This is especially useful at night. Because there is a pit (directed forward) on each side of the head, rattlesnakes can locate prey quite precisely, in much the same way as humans use binocular vision.

Rattlesnakes in British Columbia mate in late summer and early fall. Female rattlesnakes produce young in alternate years. They are live-bearing and produce from four to eight young, usually in September at or near the overwintering dens. The young are about 270 mm long when born.

Subspecies—Eight are recognized: Only the Northern Pacific Rattlesnake (*C. v. oreganus*) occurs in British Columbia.

Range and Distribution—Ranges over most of the western half of North America with a few gaps.

In British Columbia, this species is restricted to the interior Dry Belt with a range similar to that of the Racer and Gopher Snake. It is found as far east as the Cascade Mountains, west as far as Lytton (a few specimens have been found at Lillooet, on the west side of the Fraser River), and north to the vicinity of Kamloops and Cache Creek.

Rattle of rattlesnake

INTRODUCED AND OTHER SPECIES

Non-native reptiles have occasionally been introduced, either intentionally or accidentally, into British Columbia. Unlike some introduced amphibian species (i.e. Bullfrog, Green Frog), none of the introduced reptiles has been known to gain a foothold in the province; therefore we are not devoting full species descriptions to them. However, in the interests of completeness we mention a couple of examples; sightings of apparently free-living introduced species should be reported to the British Columbia Provincial Musuem.

The Snapping Turtle (*Chelydra serpentina*), a common turtle in eastern Canada, was deliberately introduced to British Columbia at Woodward's Landing (south of Vancouver) in 1913. Six were introduced, and one, presumably from the original six, was collected near Steveston (west of Woodward's Landing) ten years later. None have been seen since.

Although there have been no sightings in nearly 50 years, it would be of interest to know if any (or their progeny) still survive. The Snapping Turtle is distinctive and the following should serve as an adequate description: Body large; adult weight up to 13.5 kg and carapace length up to 470 mm. Head large with pointed snout and hooked upper jaw; neck long. Tail more than half length of carapace (may be longer than carapace in hatchlings) with saw-tooth crest of bony tubercles along its length. Carapace with three longitudinal rows of keels, which are usually worn down in large adults. Plastron cross-shaped and small, preventing withdrawal of head and legs into shell. General colouration dark brown.

The Snapping Turtle is seldom found far from water (marshes, ponds and lakes and relatively slow-moving rivers) except for females laying eggs, and rarely basks above the water surface. This is a very aggressive turtle and can be dangerous. Care should be taken to remain out of the reach of its powerful jaws; larger specimens are best handled by grasping them at the base of the tail. More complete accounts of this species can be found in some of the other field guides listed in the section *Useful References*.

Although various exotic reptiles (presumably escaped "pets") are occasionally found in British Columbia, the only published record seems to be for the Asiatic Turtle, *Chinemys reevesi*. Specimens of this animal were collected from McCoy Lake near Port Alberni in 1929. This is a small aquatic species with a carapace length rarely exceeding 100 mm.

The carapace, head, limbs, and tail are brownish, but the plastron is yellow with dark spots. Lighter markings are also found on the head. The carapace also has three longitudinal keels. It may be possible for viable populations of this species to persist on Vancouver Island since it occurs naturally in temperate regions of China and Japan, but no recent records are known.

Apart from introduced or escaped exotic species, there is also a possibility that other, naturally occurring, species of reptiles will turn up in British Columbia as our herpetofauna becomes better known. Some species in Washington range to within a short distance of the Canadian border. The Night Snake (*Hypsiglena torquata*) was in this category before its recent discovery in this province.

Among other species, the most likely to occur in British Columbia is the Western Fence Lizard (*Sceloporus occdentalis*), but other possibilities are the Side-blotched Lizard (*Uta stansburiana*) and the Ringneck Snake (*Diadophis punctatus*). Again, sightings of such species should be reported to the British Columbia Provincial Museum.

GLOSSARY

Ambient—surrounding; pertaining to the immediate environmental conditions of an animal.

Amphisbaenians—group of burrowing, usually limbless, tropical reptiles related to lizards.

Anterior—head or front end.

Antivenin—a serum against snakebite, made from the blood of an animal, usually a horse, immunized against the venom of a particular type of poisonous snake.

Carnivorous—meat-eating; feeding on animals.

Chemo-sensory—pertaining to any sensory apparatus in animals which detects the chemical nature of the environment (e.g. smell, taste).

Convection—transfer of heat through a medium (e.g. air, water) by circulation of the medium.

Crepuscular—active at twilight.

Dermal—pertaining to the innermost of the two layers of skin in vertebrates.

Dichotomous—divided into two parts.

Diurnal—active during the daytime.

Dorsal—pertaining to the back of an animal.

Emergent—rising from the water or other surrounding medium (e.g. marsh plants); emerging.

Endogenous—originating from within.

Epidermal—pertaining to the outermost of the two layers of skin in vertebrates.

Epiglottis—flap of tissue folding over the opening of the windpipe (trachea) in the throat.

Gravid—pregnant; bearing eggs or developing young internally.

Herbivorous—feeding on plant matter.

Herpetofauna—referring collectively to the reptiles and amphibians (especially the species diversity) present in a particular place or at a particular time.

Hibernate—to enter an inactive or dormant state for the winter.

Insectivorous—feeding on insects.

Intraspecific—referring to interactions or variations among individuals of the same species.

Labial—pertaining to the lips.

Microclimate—small-scale climatic conditions, usually very local in nature (e.g. the temperature or humidity within a log or close to the ground).

Microhabitat—small-scale variation in the environment (macrohabitat); an animal's immediate surroundings.

Morphological—referring to form and structure of an animal.

Nocturnal—active at night.

Nomenclature—the naming (and cataloguing) of animals; the system of giving a genus and species name to each organism is called binomal (two names) nomenclature.

Olfaction—the sense of smell.

Omnivorous—feeding on different kinds of foods, especially both animal and plant matter.

Oviparous—pertaining to animals in which the young develop in eggs laid by the mother; egg-laying.

Posterior—tail or rear end.

Polygonal—pertaining to geometric shapes having more than four angles and sides (e.g. hexagonal—having six sides).

Preocular—in front of the eye.

Retractile—capable of being drawn back or in.

Scute—an external horny or scaly plate in the epidermis.

Sexual dimorphism—the existence of differences in appearance or structure between male and female members of a species, age and season being equal.

Subcaudals—ventral scutes on the tail of a snake.

Substrate—surface on which animals walk or rest.

Tubercle—a small, knob-like process or prominence.

Valvular—having or acting as a valve.

Ventral—pertaining to the belly or underside of an animal.

Vestigial—pertaining to an organ whose size and use has diminished during evolution until only a remnant is left.

Viviparous—pertaining to animals in which the young develop within the body of the mother; live-bearing.

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For a complete listing of literature pertaining to reptiles in British Columbia, please refer to:

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INDEX, BY COMMON AND SCIENTIFIC NAMES

	Page
Boa, Rubber	69
Charina bottae	69
Chelonia mydas	34
Chelydra serpentina	94
Chinemys reevesi	94
Chrysemys picta	29
Clemmys marmorata	27
Coluber constrictor	74
Contia tenuis	71
Crotalus viridis	89
Dermochelys coriacea	37
Elgaria coerulea	55
Eumeces skiltonianus	53
Hypsiglena torquata	87
Lizard, Northern Alligator	55
Pygmy Short-horned	52
Short-horned	51
Phrynosoma douglasi	51
Pituophis melanoleucus	76
Racer	74
Western Yellowbelly	75
Rattlesnake, Northern Pacific	93
Western	89
Skink, Western	53
Snake, Common Garter	79
Desert Night	89
Great Basin Gopher	78
Gopher	76
Night	87
Northwestern Garter	82
Pacific Gopher	78
Puget Sound Garter	80
Red-sided Garter	80
Sharptail	71
Valley Garter	80
Wandering Garter	87
Western Terrestrial Garter	84
Thamnophis elegans	84
ordinoides	82
sirtalis	79

POOR

QUALITY

ORIGINAL

Index, by Common and Scientific Names—*Continued*

Turtle, Asiatic (Chinese) 94
Green 34
Leatherback 37
Northwestern Pond 29
Pacific Green 36
Painted 29
Pond 27
Snapping 94
Western Painted 33
Western Pond 27

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